DIESEL PROGRESS

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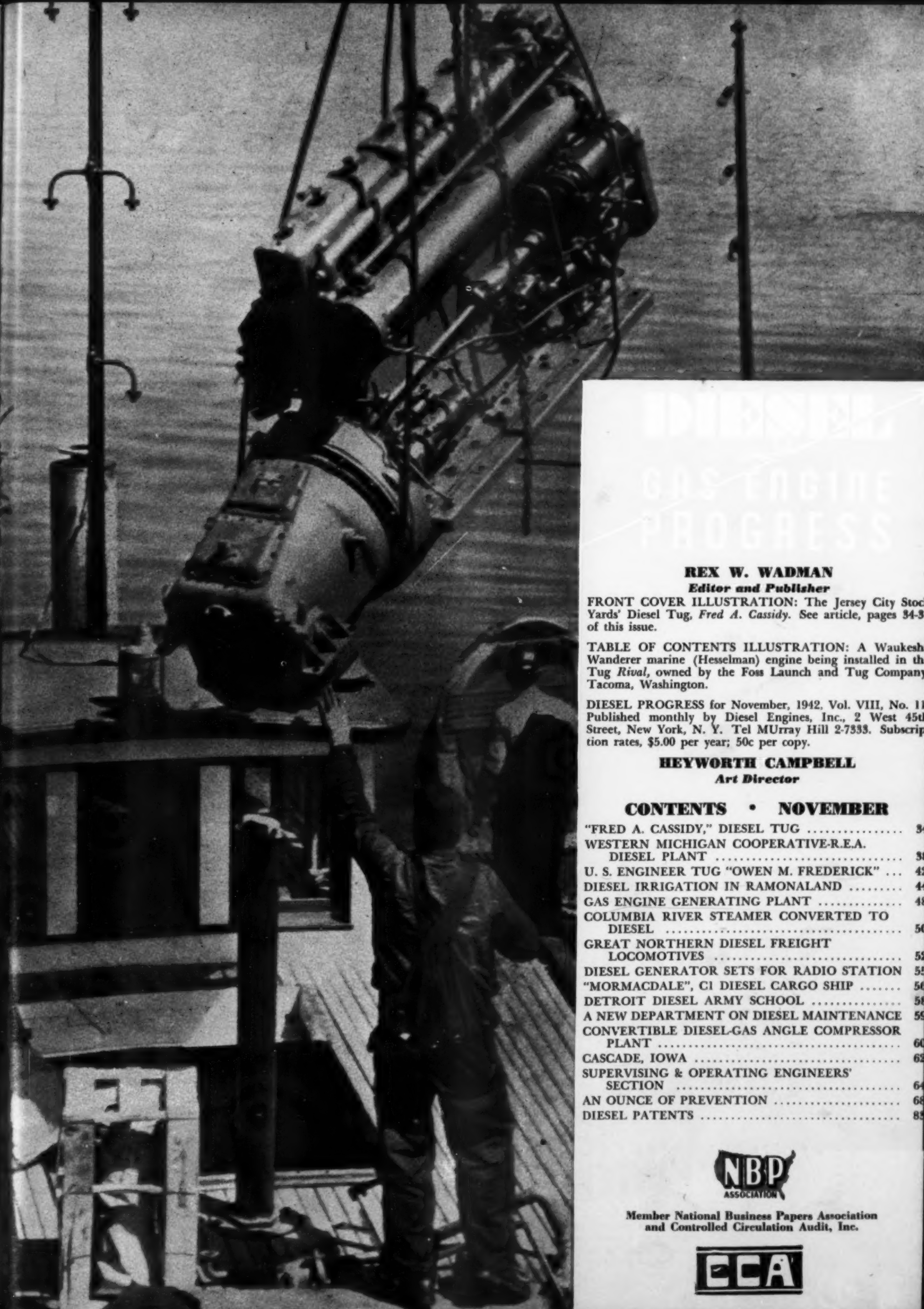

DIESEL GAS ENGINE PROGRESS

REX W. WADMAN
Editor and Publisher

FRONT COVER ILLUSTRATION: The Jersey City Stock Yards' Diesel Tug, *Fred A. Cassidy.* See article, pages 34-37 of this issue.

TABLE OF CONTENTS ILLUSTRATION: A Waukesha Wanderer marine (Hesselman) engine being installed in the Tug *Rival,* owned by the Foss Launch and Tug Company, Tacoma, Washington.

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HEYWORTH CAMPBELL
Art Director

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A SEAGOING DIESEL COWBOY

By WILBUR W. YOUNG

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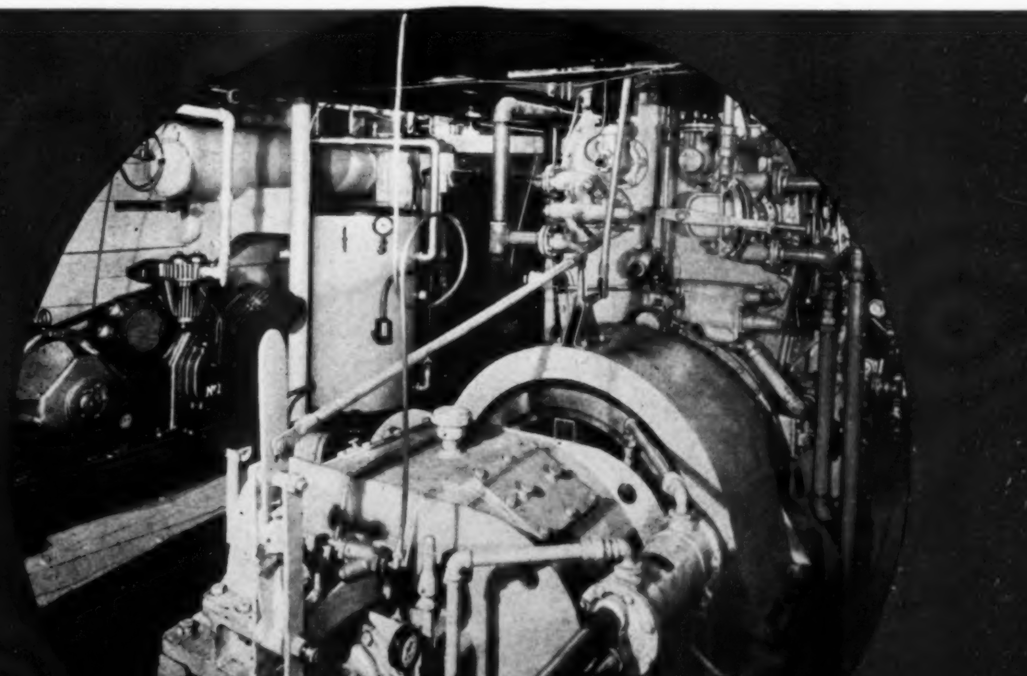
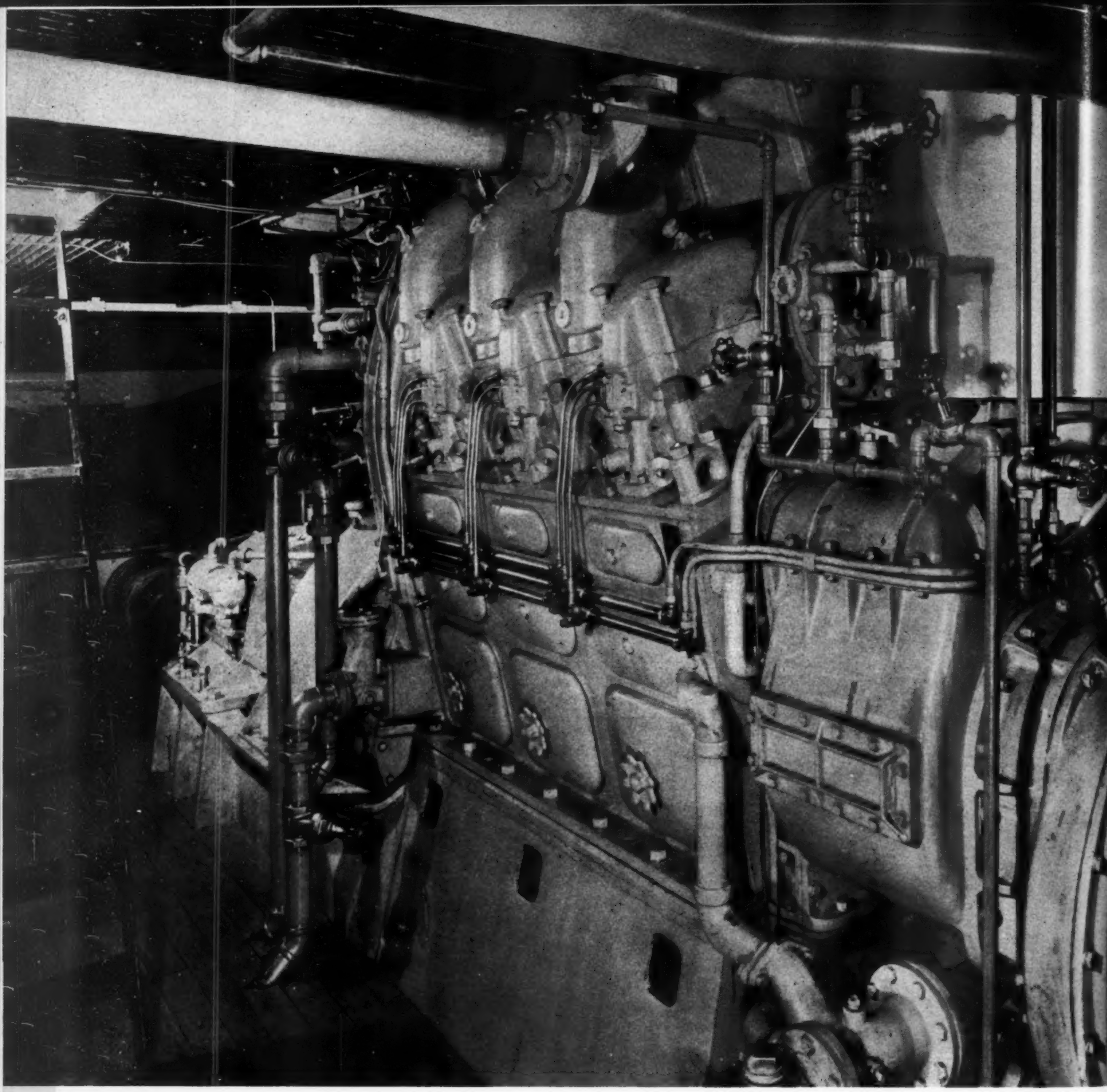
THE *Fred A. Cassidy* is a new harbor tug of special significance, employing, as she does, appropriate wooden hull construction, and Airflex clutch and reversing reduction gear, a simple but most effective adaptation of high speed Diesel motive power to direct, single screw drive. Built in the thick of war, she is a real patriot, made of non-essential and salvaged materials and parts, to a large degree, and yet put together to stay on the job a good forty years or more. And her job is to handle livestock barges—big fellows—in New York harbor—shuttling between Jersey City and West 38th and East 43rd Streets, Manhattan, for her owner, the Jersey City Stock Yards Company. The marine Diesel counterpart of a cowboy, in agility, she herds 'em in big droves, too. Designed by Eads Johnson, M. E., Inc., New York, and built by Jakobson Shipyard, Inc., Oyster Bay, N. Y., the *Fred A. Cassidy* went into service late this summer. She is 81 ft. 9 in. loa., 21 ft. molded beam, and 9 ft. deep. Her main power unit is a V-type, 6 cylinder General Motors, 2 cycle Diesel developing 600 hp. at 750 rpm., a product of the Cleveland Diesel Division. Mounted midships, this compact driving unit leaves space, forward, for the 3600 gallon fuel storage tank, switchboard and a pair of G.M. single cylinder, 15 hp. Diesel auxiliary generating sets; to starboard, the jacket water and lube oil heat exchangers and bilge pump; to port, a pair of low pressure air compressor units as well as the high pressure starting air compressor, air storage bottles, heating boiler, and storage batteries, with plenty of room for free movement of the engine crew. In the July, 1939, issue of DIESEL PROGRESS, Rex W. Wadman, Editor and Publisher, after describing the first application of the Airflex clutch under the title, "A Rubber Tired River Towboat," made this prophetic observation: We will look back on this somewhat prosaic little work-boat as pioneering a new and revolutionary type of marine drive." Well, there have been many successful applications of this drive since that day—most of which came under war censorship but here is one that is right out in the open. No longer revolutionary, the Airflex clutch as employed in the tug, *Fred A. Cassidy*, today is a tried and approved power transmission unit having the advantages of efficiency and economy of space at low cost. Here is what it is and how it works. The complete unit, mounted on the engine bed extension aft, consists of a Falk reversing reduction gear and a pair of Airflex clutches. The single-reduction gear ratio for forward rotation is 3.48:1. For reverse rotation, the power is transmitted through two idler gears with a step-up ratio of 1.24:1, the idler pinion being keyed to the main reverse pinion which drives the main gear. Final reverse ration is 3.50:1. The two Airflex clutches are mounted in the flywheel extension which is bolted directly to the flywheel. Engagement of the forward clutch with the drum mounted on the high speed pinion shaft transmits power directly to the main reduction gear. The aft clutch is engaged for reverse rotation, the power then going through the reverse idlers and thence through the main gears. Connection to the propeller shaft is through a solid steel flange coupling. This marine type Airflex clutch consists of a rubber gland molded to a steel rim. The gland is constructed to receive air so that it can be constricted in diameter to engage the outside diameter of the drum. There are two glands, each with an independent air supply line. To engage the clutches with the drum, air at 100 psi. is admitted to one or the other of the clutches, depending on the direction of rotation desired. Yes, simply a pair of rubber tires, the inflation or deflation of which applies power to the main shaft, and smoothly, throughout the speed range from 375 rpm. idling to top engine speed. A General Motors designed pilot house control, connected through linkage to the clutch air valve and interlocked with the engine speed control governor, gives the Captain positive finger tip control of all maneuvering except starting and stopping the engine; just like handling an automobile. A look at a few details of her hull construction supplies evidence



Upper left: Built for a long, busy life, the wooden hull Diesel tug "Fred A. Cassidy" is shown under way on trial run. Left: Pilot house view showing GM remote clutch control, left of wheel. Above: Close up of Falk reversing reduction gear and Fawick Airflex clutch.



that the *Fred A. Cassidy* was planned for a long, useful life. For example, the keel is white oak sided 12 in., molded 12 in. in two lengths scarphed 6 ft. with 2½ in. nibs, keyed and fastened with ⅞ in. galvanized bolts. The Stem is of white oak sided 12 in. cut from crooked timber; frames of white oak, 24 in. center to center, doubled, sided 5 in. and molded 10 in. at keel. The center keelson, of oak, is made up of three members, one 12 in. by 12 in. and two 10 in. by 12 in., running along the top of the frames, scarphed to deadwood at each end and fastened to the keel. Additional keelsons of rugged dimensions were installed in wake of the engine so that the power unit is down to stay and she is notably free from vibration. That is the way her specifications run but there is clear evidence on every hand that her builder leaned toward the baker's dozen idea in quality and quantity. Many familiar suppliers also had a hand in outfitting this splendid craft. For example, accessories on the main engine include a Purolator fuel filter, Fullflo lube filter, Marquette speed control governor and over speed trip, Air-Maze oil bath air cleaner and oil separator, Maxim exhaust silencer, Brown pyrometer, and Schutte & Koerting heat exchangers for jacket water and lube oil cooling. Engine rpm. is indicated by Weston tachometers in engine room and pilot house. The twin, 15 hp., auxiliary Diesels drive Westinghouse generators and are fitted with Delco-Remy electric starting, AC fuel filters, Fullflo and Skinner lube filters, and AC air cleaners. A pair of Ingersoll Rand, GE motor-driven compressors supply

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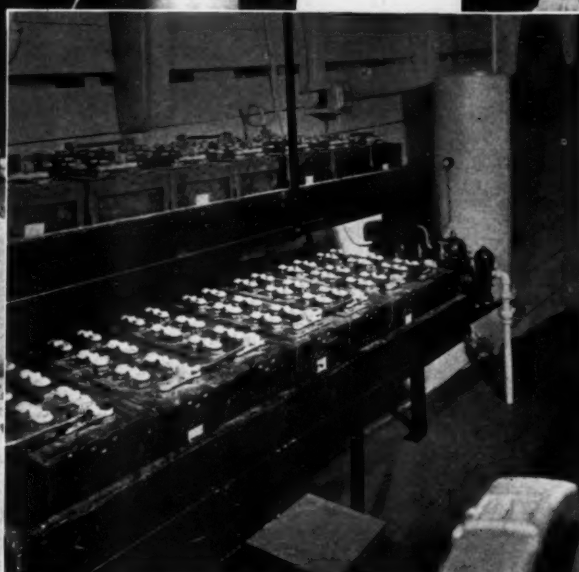
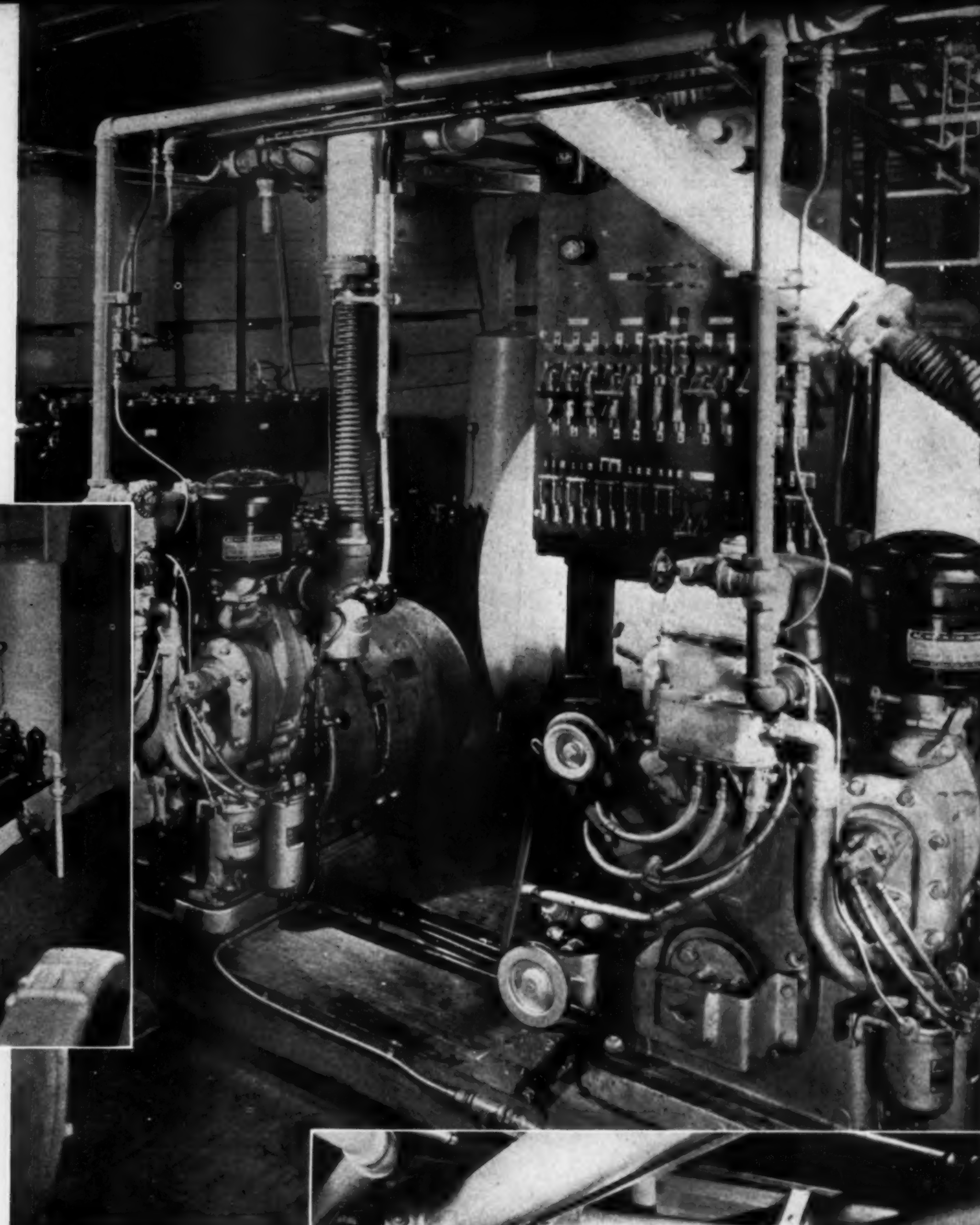
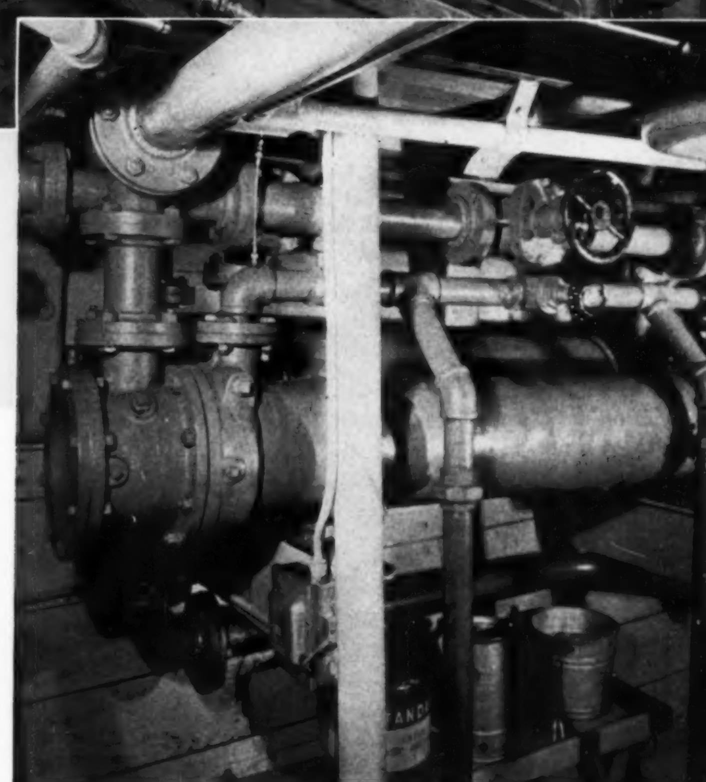






air at 100 psi. for maneuvering the clutches and high pressure air for engine starting is supplied by a Worthington compressor driven by an Imperial electric motor. Oil and air gauges are U.S. Ship lighting and service and auxiliary engine starting batteries are Exide Ironclad. She is every inch well built, well powered and well equipped. President Fred A. Cassidy of the Jersey City Stock Yards Company, who swears his name was literally taken away from him for this fine tug—and you can believe him —is justly proud of her.

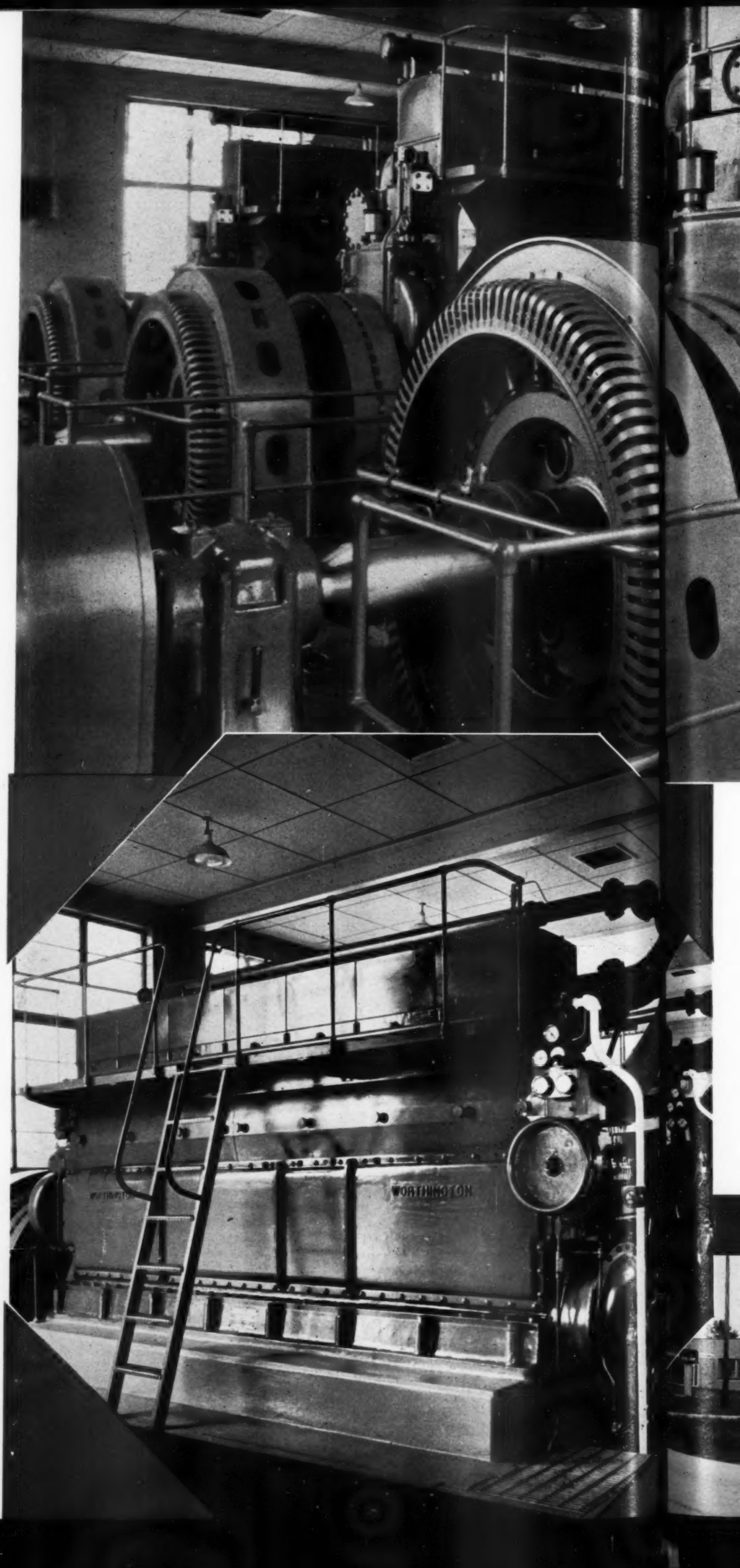
Upper left: Forward end of General Motors, 600 hp., 2 cycle main Diesel. Note Purolator duplex fuel filter and Air-Maze air filter, foreground. Center: One of the two banks of Exide Ironclad batteries. Above: Duplicate G.M. 15 hp. Diesel auxiliary generating units. Right: Schutte & Koerting jacket water and oil cooling heat exchangers.

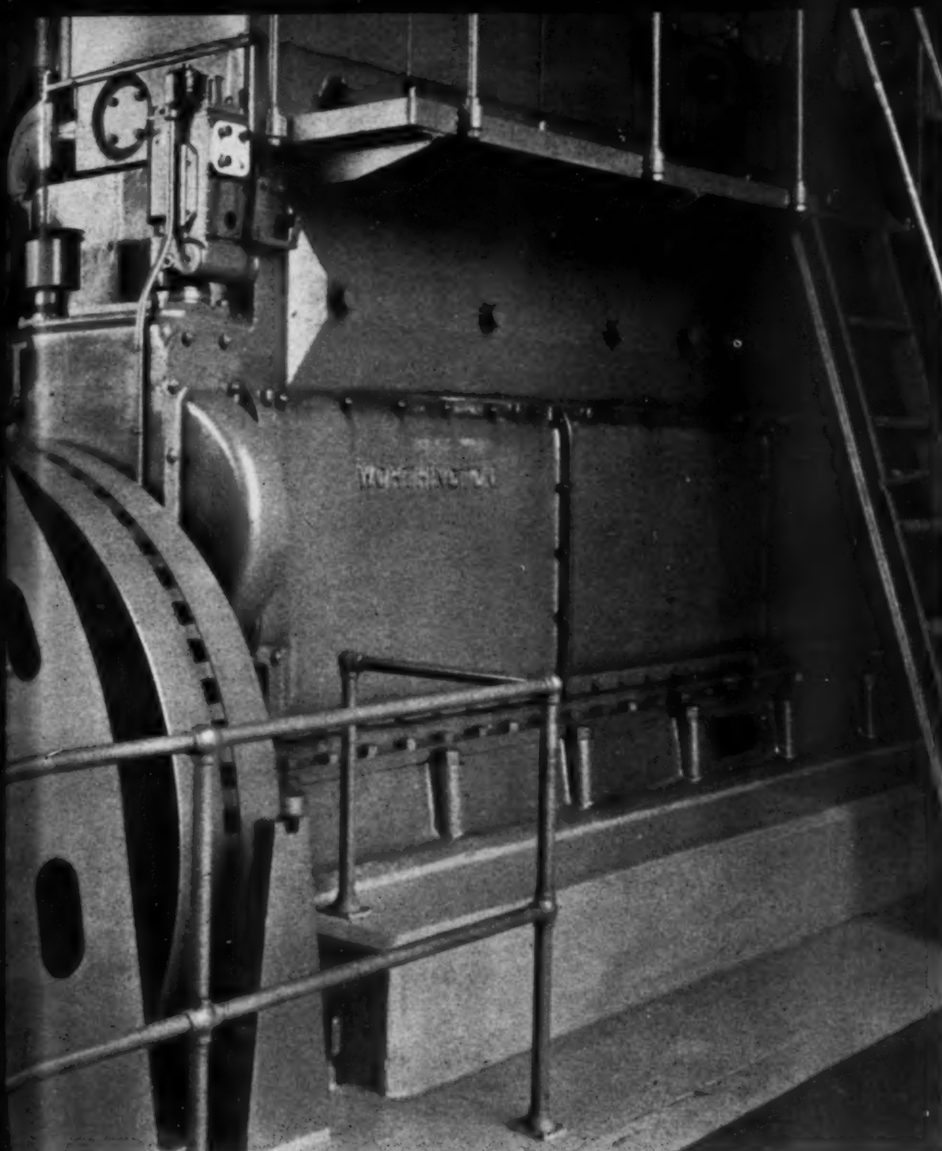
RURAL electrification engineers have built some of the nation's most impressive Diesel power plants, but none surpasses the new plant of the Western Michigan Electric Cooperative in attractiveness and modern design. It is fitting that these rural power producers should embody the latest facets of architecture and power engineering, for they symbolize the urban modernity that is fast invading the American countryside. Today they are also an important symbol of the universality of the nation's war effort, for many plants designed to give the convenience of electric light and power to farmhouses are generating power for small war factories that have sprung up in the villages of their territory.

The Western Michigan Electric Cooperative power plant was put into service last year to serve 1,165 consumer-members on 340 miles of line in Mason and Lake counties, West Central Michigan. Arrangements were made also to serve an extensive rural cooperative to the South but the conservation of copper has made the tie-in impossible for the present. To meet the total anticipated demand and provide adequate reserve power to accommodate normal load development, Western Michigan installed three 595 hp. Worthington Diesels direct-connected to 340 kw. 3 phase, 60 cycle, 2400 volt, Electric Machinery synchronous generators with V-belted exciters. Each of the Diesels has seven cylinders of 13¼ in. bore and 17½ in. stroke and develops rated horsepower at 360 rpm. The engines are of the 4 cycle, mechanical-injection type.

The building has three integrated sections which house all branches of the Cooperative's operating force. One section includes the administrative offices and a combined business office and electric appliance showroom. A second section includes garages, store rooms, and work rooms for the distribution and service departments. Properly dominating both is the large power house with broad, high windows in the modern style. It is evident at first glance that this is a completed plant, not one where additions will be tacked on to the building every few years. The original structure is large enough to accommodate five engines of the type installed, providing sufficient horsepower to serve 3,000 Co-Op members which is considered the saturation point for the territory. Any expansion beyond that would justify erection of a second plant to share the load.

The power house interior is a model of order and cleanliness. The walls are lined with tile; the concrete floors are waxed and polished and rubber runners take the wear. Engines, switch-

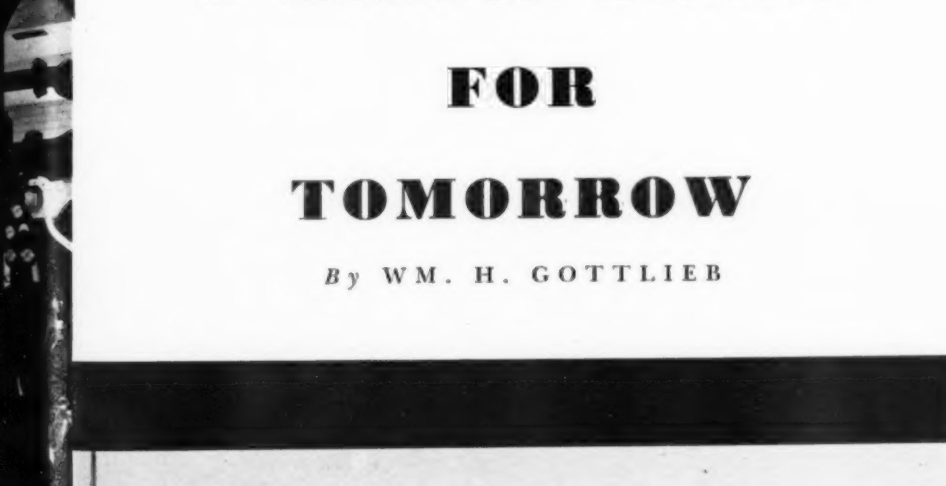




Above: The three 595 hp. Worthington Diesels and EM generators in the Western Michigan Cooperative plant. Note Pickering governors. Left: Operating end view of the Diesels showing Alnor pyrometers and Manzel lubricators.

A DIESEL PLANT FOR TOMORROW

By WM. H. GOTTLIEB



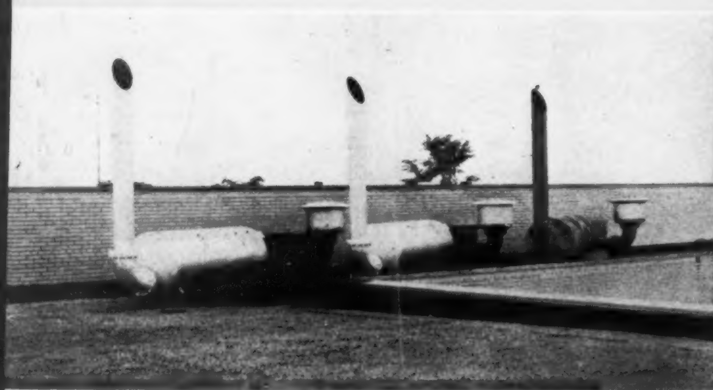
board, and most of the accessory equipment are on the main floor so that one operator can conveniently supervise all operations. Only the lube oil coolers and purifiers are in the basement. The all-enclosed engines carry out the streamlined effect.

Though the visual assets are a striking feature of the plant, by no means do they overshadow the completeness and quality of the equipment. The compact, heavy-duty Diesels have lubricating and cooling systems designed to preserve and prolong engine life and efficiency; plant auxiliaries are so arranged that they operate automatically.

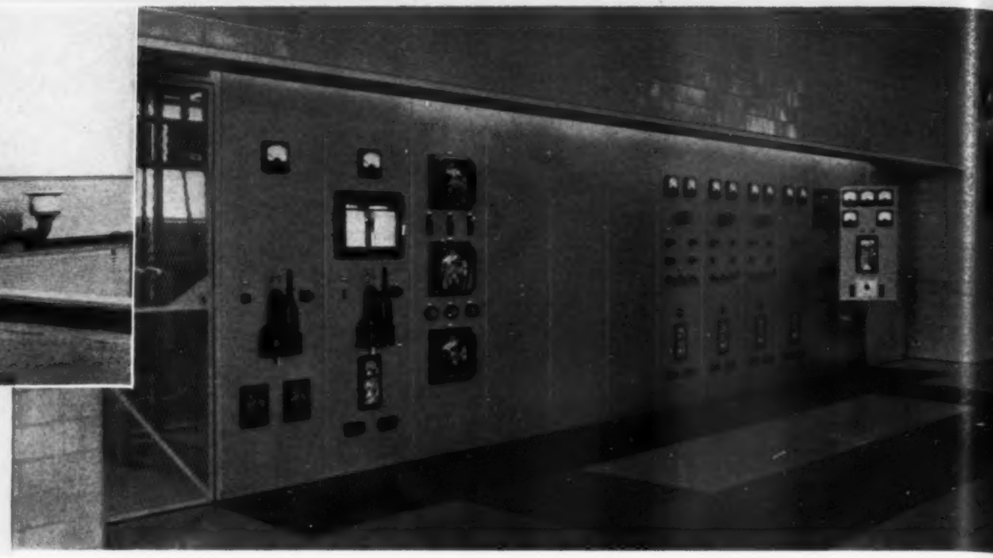
Key units in the closed cooling water system are two large American Blower evaporative coolers, equipped with automatic controls to keep jacket water at the desired temperature without attention from the operator. Part of the time, these coolers act as radiators with powerful fans drawing air from outside the building across the coils carrying the jacket water and discharging the hot air through a second duct to the outdoors. A Minneapolis-Honeywell temperature controller operates shutters on the intake air duct, thus regulating the quantity of air blown across the water coils. When the maximum quantity of air is not sufficient to hold jacket temperature down, another temperature controller starts a built-in motor-driven pump which sprays water over the hot coils. In this manner, the unit reaches its maximum cooling potential as an evaporative condenser. Jacket water is circulated through the engines and coolers by four 2½ in. Worthington "Monobloc" centrifugal pumps each driven by a 7½-hp. motor. There is one pump for each engine and the fourth serves as a standby.

Even the addition of makeup water is completely automatic. A vertical Fairbanks-Morse well pump inside the plant feeds makeup water into a large pressure tank from which it flows through a meter to a Warlow softener and then into the jacket water system. Actuated by the pressure in the tank, water enters the engine system as needed. The resultant drop in tank pressure starts the well pump by means of a Mercoid switch and Cutler Hammer motor control and water is pumped into the tank until the pressure is restored.

The engines are completely pressure lubricated with a crankshaft-driven pump drawing oil from the crankcase sump and sending it under pressure through a header in the base with cast-in branches to each main bearing, then through passages in the crankshaft and con-



Roof view showing Air-Maze intake air filters and Burgess exhaust Snubbers.



The GE dead front switchboard is equipped with GE instruments and switchgear and Allis-Chalmers voltage regulators and synchronizer.

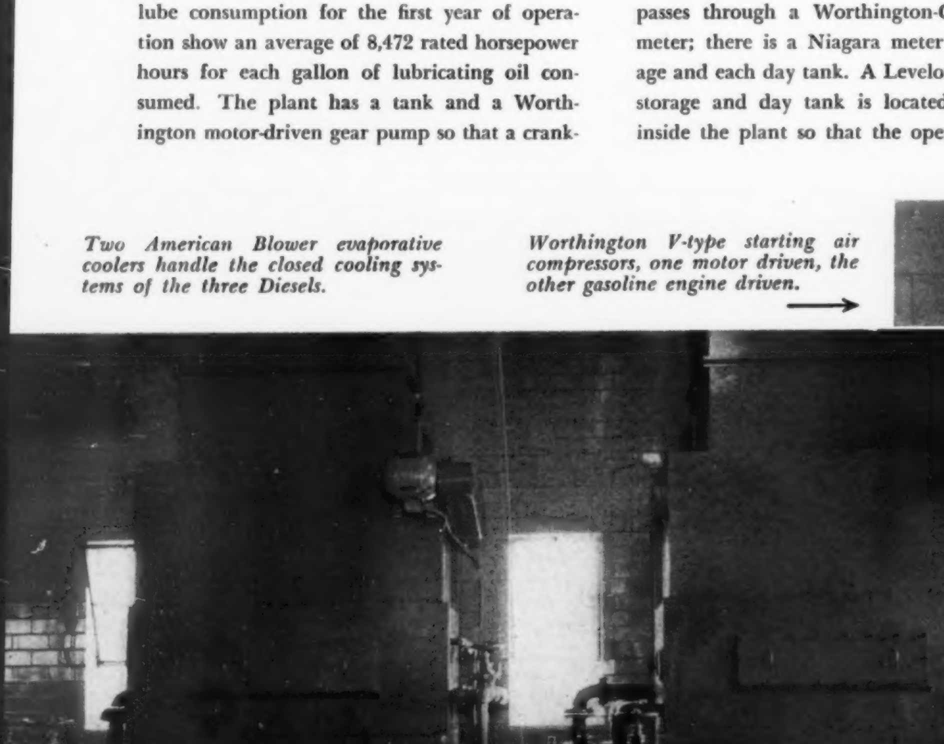
necting rods to the crank and wristpin bearings. Cylinders are supplied with lube by Manzel force-feed lubricators. The lube circulating system of each engine includes a Ross oil cooler, a duplex Cuno filter and a Honan-Crane activated clay purifier arranged for continuous operation. With this system, no oil need ever be discarded and the engine supply is always clean. Lubricating oil economy has been notable. About 1½ to 1¾ gallons of Sinclair Rubilene Medium Heavy is added to an engine's cylinder lubricators in a 24 hour run. None is added to the crankcase. Figures available on lube consumption for the first year of operation show an average of 8,472 rated horsepower hours for each gallon of lubricating oil consumed. The plant has a tank and a Worthington motor-driven gear pump so that a crankcase can be very quickly drained for inspection and maintenance.

The Leonard No. 3 fuel is stored in two 25,000 gallon tanks resting on concrete cradles to the rear of the plant. Two Worthington motor-driven gear pumps can be used to unload fuel from either tank cars or trucks and also to transfer the fuel to the three 250 gallon day tanks on a high platform inside the plant. From this point the oil flows by gravity through individual Niagara strainers and Cuno filters to each engine. Fuel unloaded into storage passes through a Worthington-Gamon master meter; there is a Niagara meter between storage and each day tank. A Levelometer for each storage and day tank is located conveniently inside the plant so that the operator can control fuel transfers readily. For fuel injection there is an American Bosch injection pump and differential spray nozzle for each cylinder, with size of the fuel charge regulated by a Pickering relay-type governor on each engine.

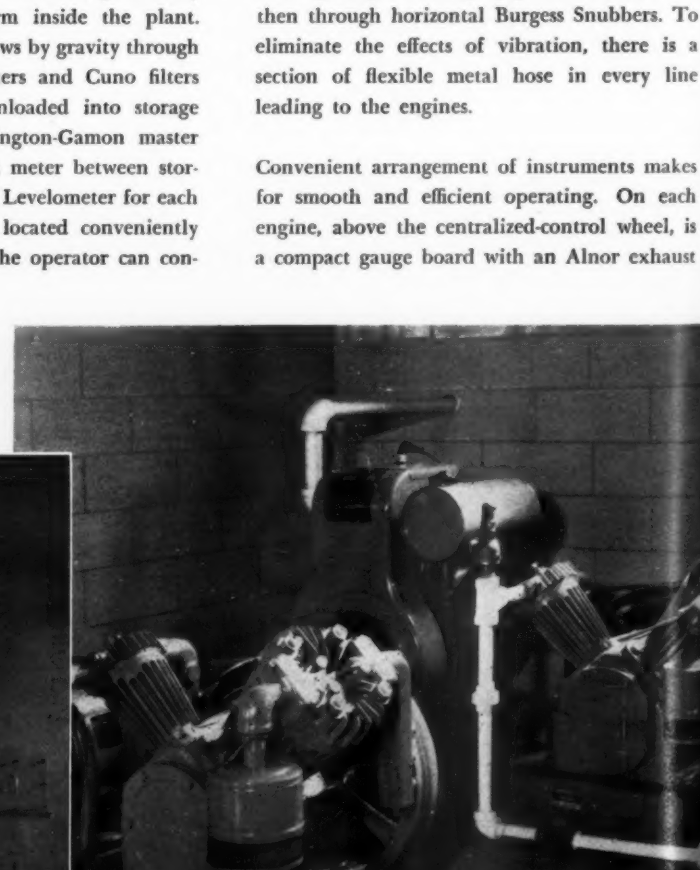
Intake air for each Diesel is drawn through an Air-Maze oil-bath filter on the roof. Exhaust gases pass through pipes to the roof and then through horizontal Burgess Snubbers. To eliminate the effects of vibration, there is a section of flexible metal hose in every line leading to the engines.

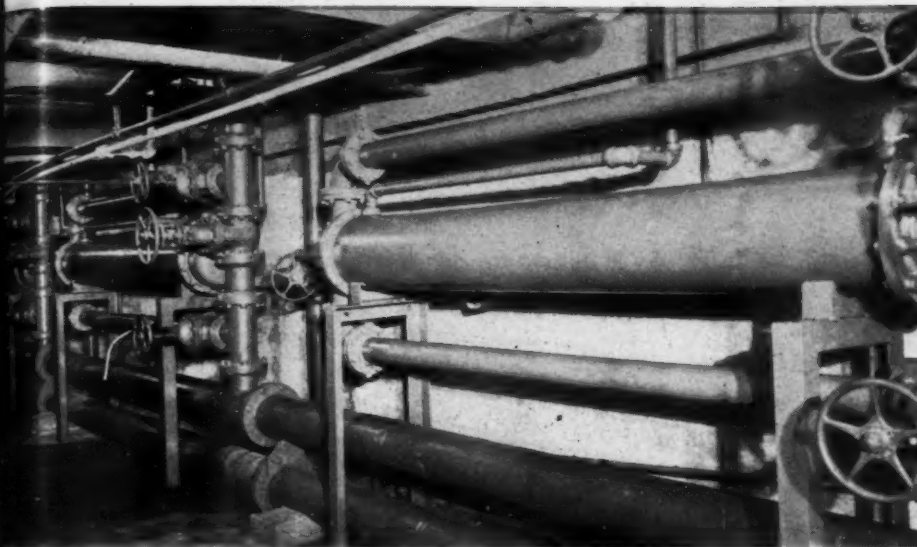
Convenient arrangement of instruments makes for smooth and efficient operating. On each engine, above the centralized-control wheel, is a compact gauge board with an Alnor exhaust

Two American Blower evaporative coolers handle the closed cooling systems of the three Diesels.

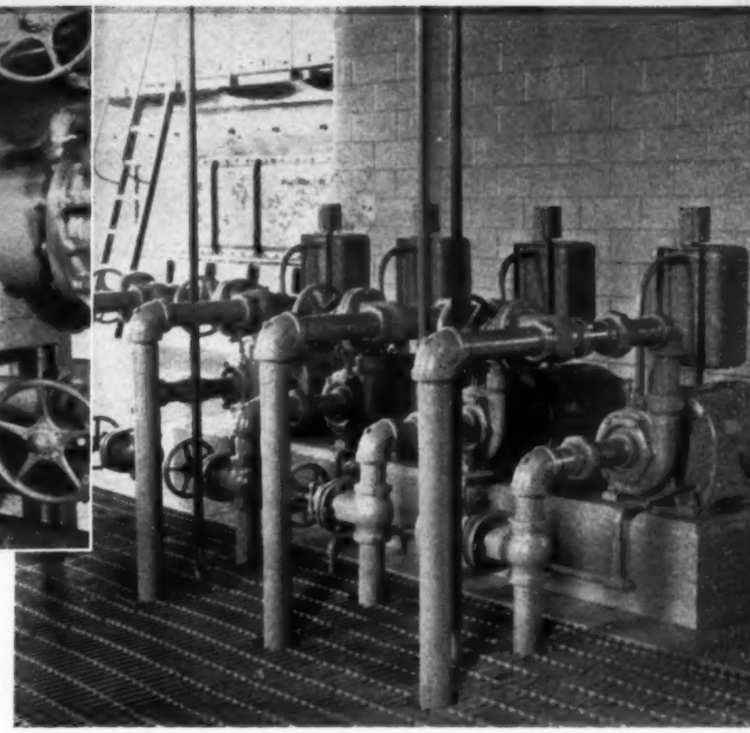


Worthington V-type starting air compressors, one motor driven, the other gasoline engine driven. →





Ross lube oil coolers, one for each Diesel, are installed in the power plant basement.



Battery of Worthington "Monobloc" centrifugal cooling water circulating pumps.

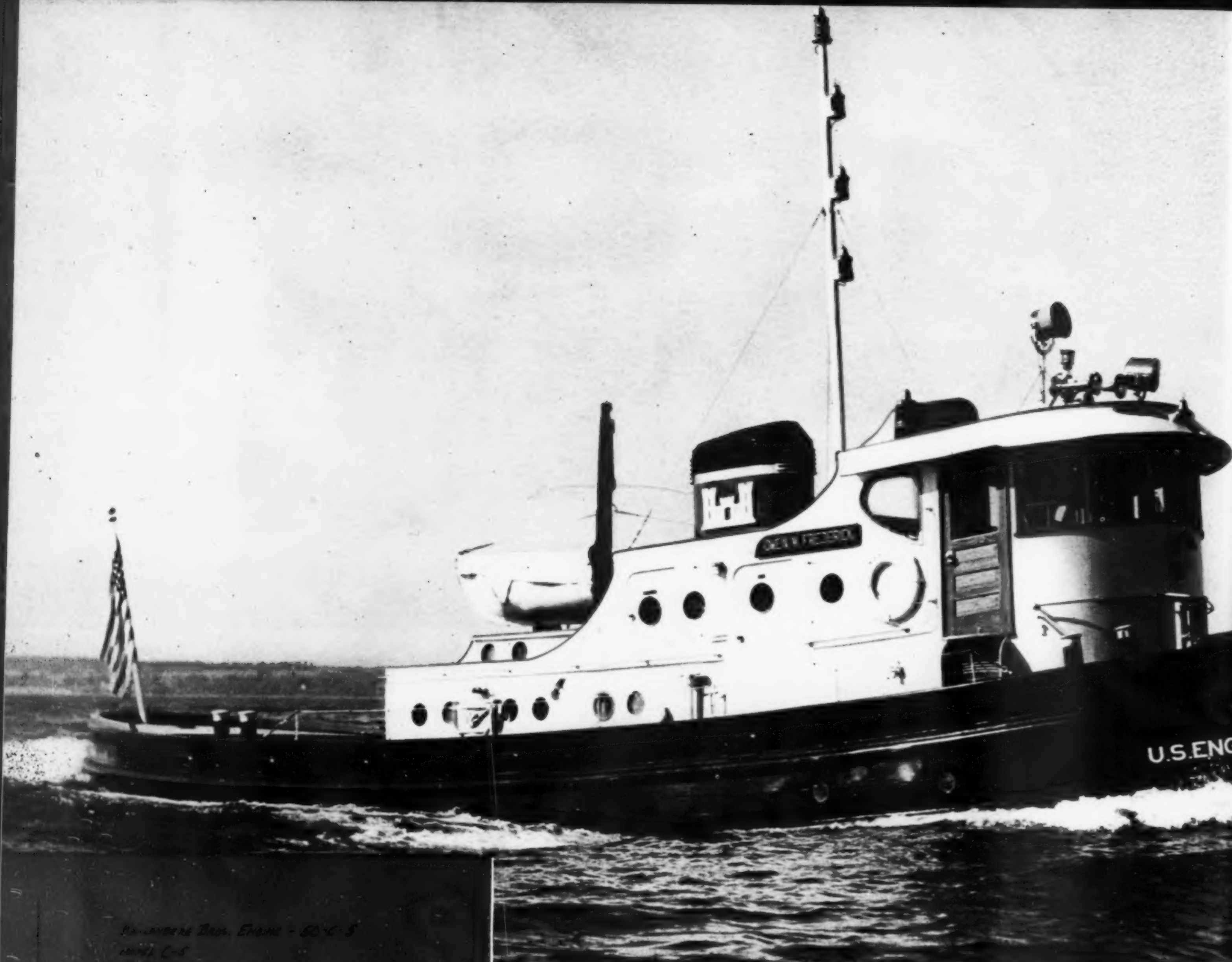
pyrometer and pressure gauges for fuel, lube, water and air. The light grey, fluorescent-lighted, G.E. switchboard is particularly well equipped and convenient. The G.E. kilowatt meters and ammeters have selector switches so that the operator can take the reading for any one or combination of engines. One panel is devoted to the alarm system and accessory equipment motor controls. There are alarms on lube pressure, water pressure, water temperature, over speed and high and low fuel day tank levels and an Edwards annunciator points out the seat of the trouble. One panel holds three rocking contact Allis-Chalmers voltage regulators and a swinging panel holds an Allis-Chalmers automatic synchronizer. Also on the board are engine-speed controls, G.E. totalizing kilowatt-hour meters, time over-current relays and oil circuit breakers, and an Esterline Angus recording volt meter and kilowatt meter. With an eye toward the future, three extra switchboard panels were included to take care of the plant expansion.

For starting air the plant has two $4\frac{1}{4}$ in. x $2\frac{1}{2}$ in. x $2\frac{3}{4}$ in. V-type Worthington compressors, one belted to an electric motor, the other to a Wisconsin gasoline engine. There is an I beam directly over each engine and a three ton Goffings hoist on each to ease maintenance work. It should be noted that the plant was designed and constructed by the General Engineering Co. of Minneapolis under the general supervision of Franklin P. Wood, head of the Generation and Transmission Section of the Rural Electrification Administration.

In the absence of copper to effect the tie-in with the neighboring Cooperative, a large portion of the plant's anticipated load was a war casualty, and so the first year of operation amounted to scarcely more than a break in period with production under a million kilowatt hours. But power does not go begging in these days and Western Michigan's surplus capacity is being geared to important service. For the present, the Diesels have a job to do. After the war, the plant will be ready to extend its intended peacetime service—the provision of efficient, economical electrical energy to the farm homes of Western Michigan. The plant can carry unexpected loads today and will meet adequately the augmented peacetime demand because it was designed to meet tomorrow's needs.

Worthington, gear type, fuel transfer pumps and Levelometer gauges for fuel storage tanks.

A Honan-Crane lube oil purifier and Worthington lube transfer pump, like those shown here, are installed for each Diesel.



Top View: "Owen M. Frederick" on trial run off the builder's yard in Sturgeon Bay, Wisconsin. Above: Plot of the results of the progressive bollard test.

U. S. ENGINEER TUG "OWEN M. FREDERICK"

By WILBUR W. YOUNG

THE U. S. Engineer Department, Marine Design Section under Colonel H. B. Vaughan, Jr., develops plans for many types of vessels all with characteristically pleasing but sturdy lines regardless of class. In the Diesel tug *Owen M. Frederick,* Colonel Vaughan has again achieved something that immediately marks this vessel as a U. S. Engineer craft. Viewed from any angle, inboard or outboard, stem to stern, she is built for business—for the special kind of business intended by her designers and builders. The contract for building this interesting tug was given to Sturgeon Bay Shipbuilding and Dry Dock Company whose president is Captain John Roen, a man widely known along the Great Lakes for his shipbuilding activities and for his unusual salvage operations. The *Owen M. Frederick* is of all welded steel construction having an overall length of 64 ft. 9 9/16 in., a breadth, overall, of 17 ft. 7 5/8

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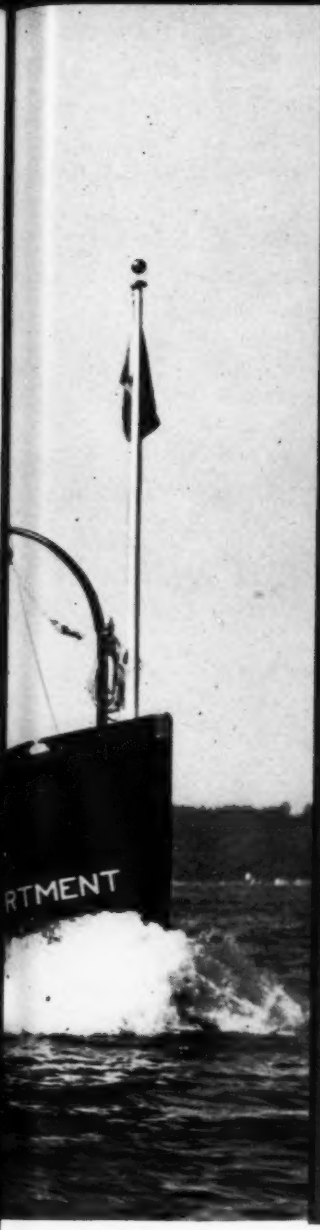

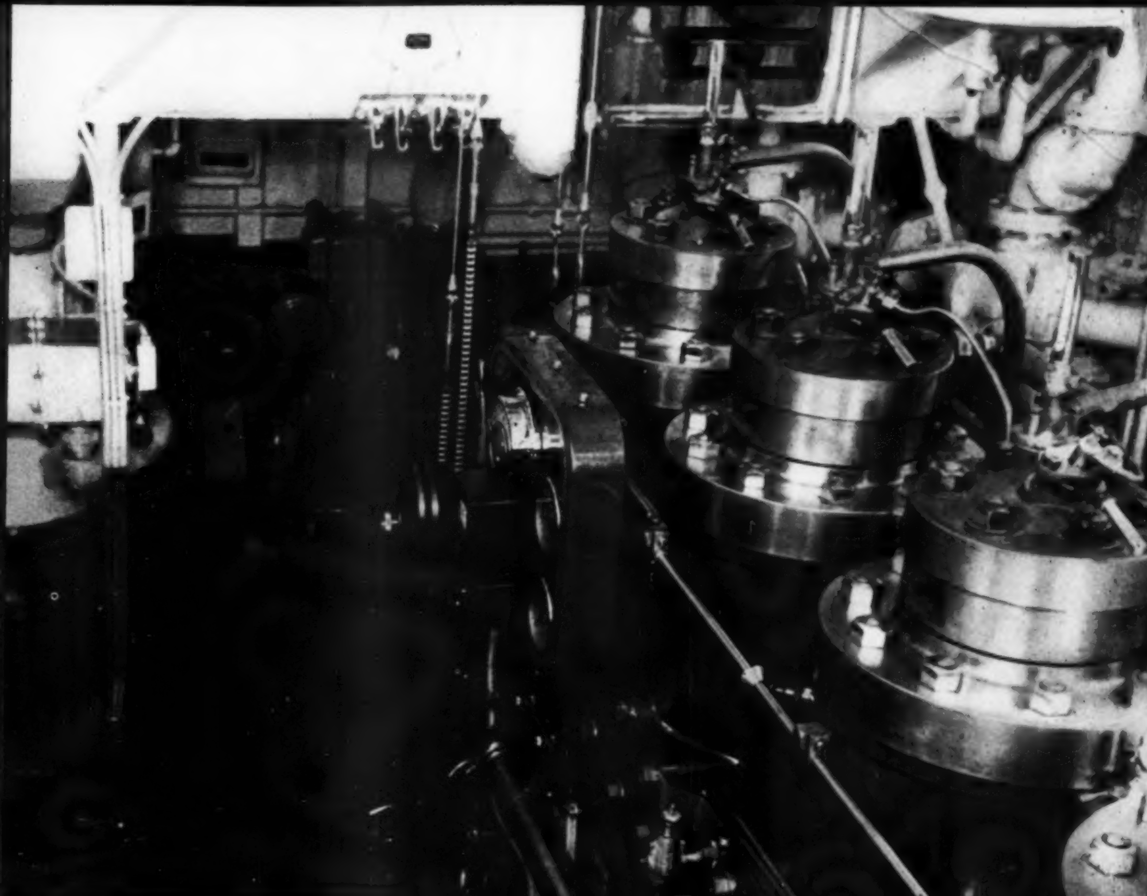

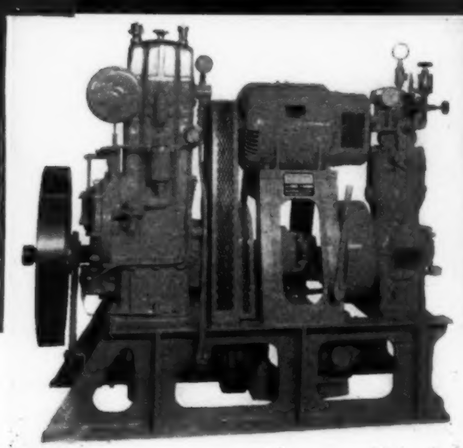

Above: Engine room view showing main Kahlenberg Diesel. Note instrument panel carrying Weston tachometer and Alnor pyrometer. Left: Closeup of the Reiner auxiliary unit, partly showing in background above.

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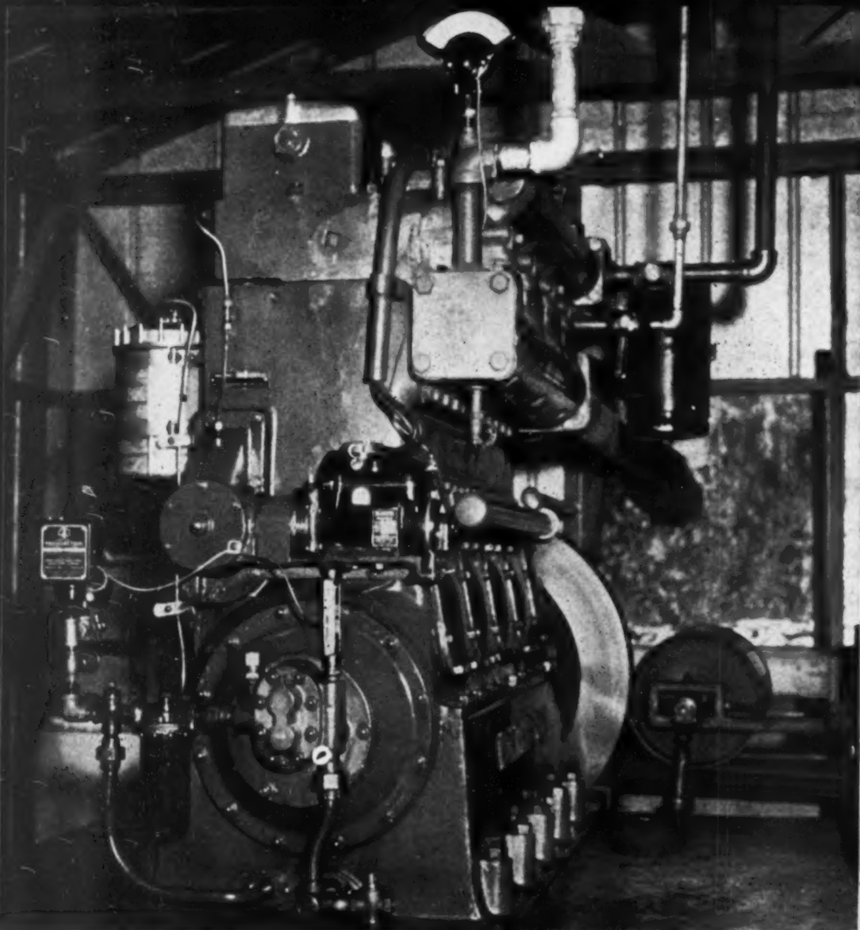
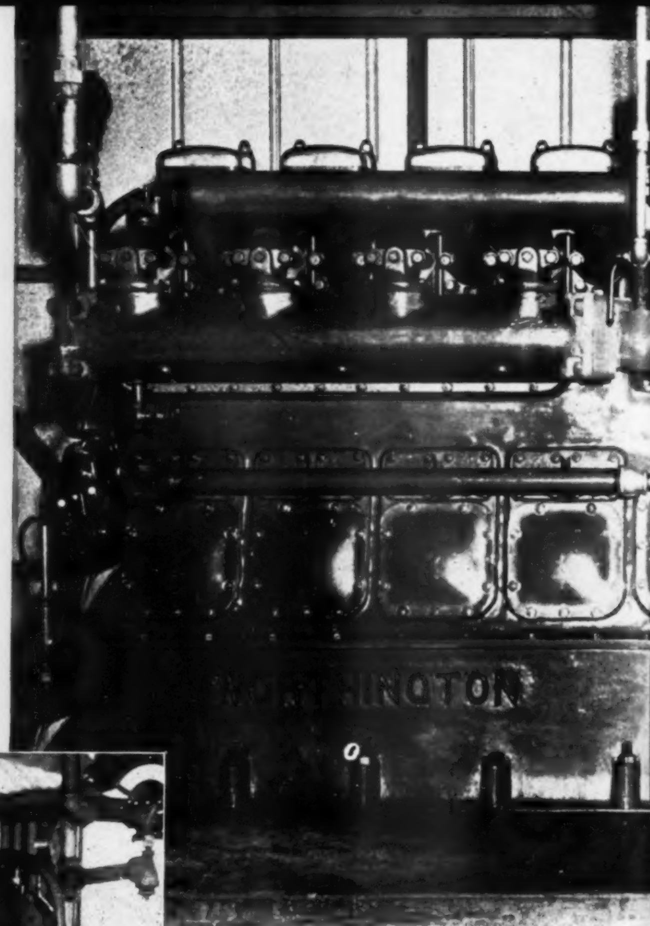
in., and a molded depth of 7 ft. 7½ in. The hull is sub-divided by three full transverse watertight bulkheads and there is a single deck. The galley is on deck, a double berth in the pilot house and quarters for crew of four are in the forecastle. She carries 1000 gallons of fuel oil, 315 gallons of fresh water. So loaded and with all supplies and full complement aboard, she has a draft of 7 ft. aft, and 5 ft. forward. Not a big tug as tugs go, neither is a PT boat big as boats go—but what a wallop some of these small fellows have.

The main propelling engine is a Kahlenberg, 5 cylinder, 12½ in. bore, 14 in. stroke direct reversible, full Diesel, rated 250 hp. at 325 rpm. The three-blade, 60 in. by 45 in. cast steel propeller, specially designed by Dravo, was made by Kahlenberg. The auxiliary set is comprised of a single cylinder Diesel, with generator, air compressor, fire and bilge pumps all built into a compact unit with suitable clutches by John Reiner. She carries an Exide Ironclad, 112 amp. hr. storage battery. The fuel, lube, portable and sanitary water pumps are Dunning. Penflex tubing carries the main engine exhaust to the silencer in the stack. The thing that enhances the wallop of the main Diesel is a Kort nozzle. Built as a complete unit at the Neville Island yard of Dravo Corporation, the Kort nozzle was attached to the hull at the shipyard. The nozzle is of all welded steel construction having an outside shell supported by two ring frames interlocked with twelve radial diaphragms. A heavy cylindrical ring is fitted on the inside of the nozzle in way of the propeller.

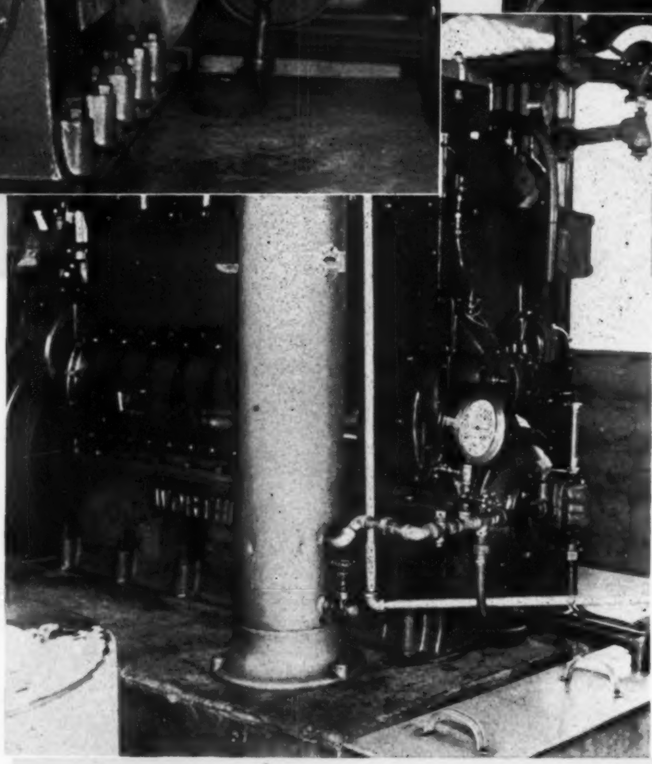
The apron and fairing plates were fitted by the shipbuilder. Tests at the shipbuilder's yard showed especially good performance of the tug. At the progressive bollard test, the maximum pull at 360 rpm. of the engine was 12,400 pounds with an exhaust temperature of approximately 450 degrees Fahrenheit. At 340 rpm. of the engine, the tug running free attained a speed of 10½ miles per hour.

She carries complete and modern equipment for keeping her going in all kinds of weather. A fully automatic York heating boiler, Webb oil burning galley range, Copeland electric refrigerator, Kahlenberg air horn, 14 in. "Lebby" searchlight, 12 ft. life boat with capacity for six persons and complete fire fighting equipment by Walter Kidde. All plumbing fixtures are Crane. The ***Owen M. Frederick*** was designed and built for service at St. Mary's Falls Canal and they get some tough winter weather up there.





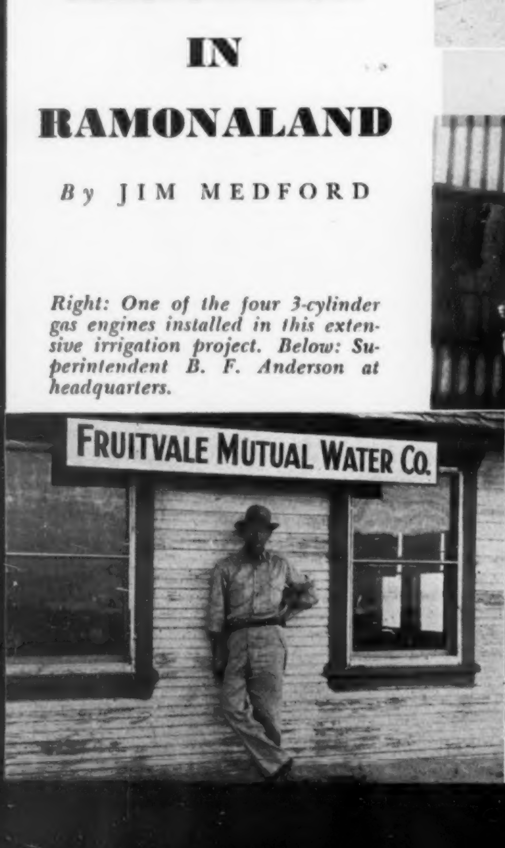
Above: Worthington gas engine in Plant No. 7. Note Bendix-Scintilla Magneto, Luber-Finer fuel filter, Purolator lube filter, Pressurtrol control switch, and Vortox air cleaner. Right: View of the 5-cylinder, 75 hp. gas engine showing Luber-Finer lube filter, foreground.

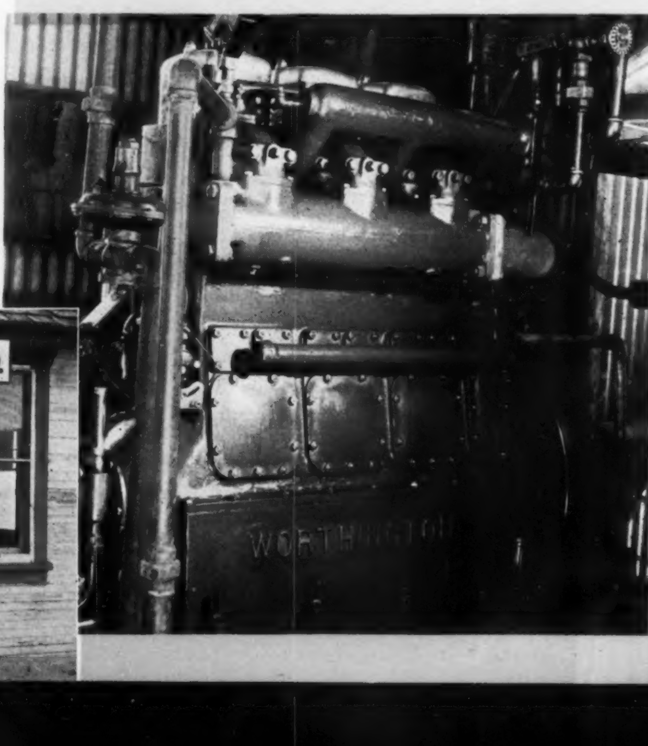


GAS ENGINE IRRIGATION IN RAMONALAND

By JIM MEDFORD

Right: One of the four 3-cylinder gas engines installed in this extensive irrigation project. Below: Superintendent B. F. Anderson at headquarters.



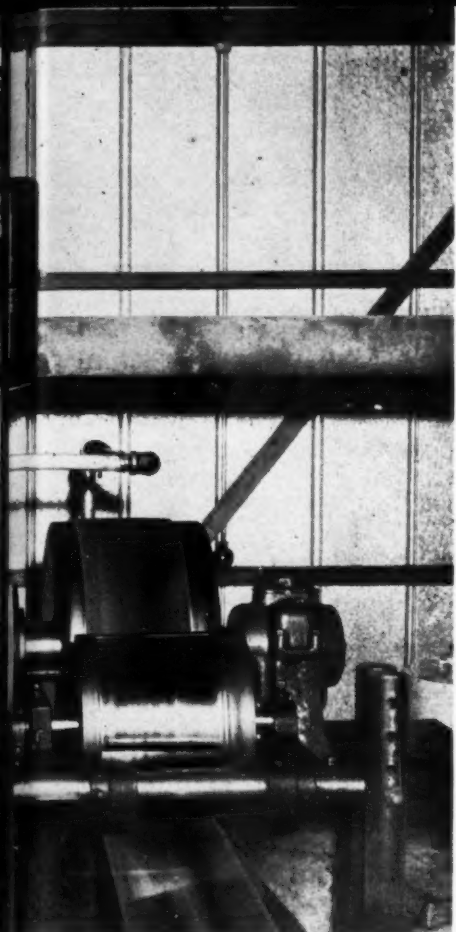


SAN Antonio Bucarli it was called in 1774 when Juan Bautista de Anza, Spanish caballareo and explorer, rode out of the South, stopping at Casa Loma Rancho of historic California Pico family near the San Jacinto of today.

Located in Riverside County at the base of 11,000-ft. Mt. San Jacinto, the Hemet-San Jacinto valley has become famous for its rapid development during the last half-century; and because it is the setting for the typical early-California historical "Ramona Outdoor Play," until this year an annual event since its conception in 1923.

Fogless and with an elevation of 1,600 feet, this one time arid valley, because of irrigation, has become an agricultural production center of $3,000,000 per year, producing everything in livestock from cattle to turkeys; oranges, peaches and olives, to melons and field seeds. All impossible without that king of kings in the desert—water.

During nearly half of the Hemet-San Jacinto



valley development — the big half, too — the Fruitvale Mutual Water Company has been serving 4,000 acres of the district's best land.

It began back in 1920 when the Mutual took over from a public utility, continuing to use the installed electric power until they could check up on what it was all about. Being a cooperative company composed of ranchers long used to electric power, interest in the use of any other type of energy was slow developing.

Ten years drifted by. Reports of the economy of Diesel engines were coming in, particularly those converted for burning natural gas. Now that natural gas idea was something—no storage, no transportation. And plenty handy.

When the 1931 report came out, the members sat up and really took notice. Delivering 164,000 California miner's inches (9 gallons) per day was costing 9.01 cents per inch. Too much, they said. They'd been hearing that, over in the Antelope Valley 125 miles to the west, Diesels had cut irrigation costs to where the growers could make a profit on \$12 alfalfa hay. If this was so there, why not here?

But three years came and went. It was 1934. These Diesel sales-engineers get around, and the Mutual shareholders didn't believe in half measure when their minds were made up. From the Los Angeles branch of the Worthington Pump and Machinery Company they purchased and put into service seven gas engines—four 3-cylinder, two 4-cylinder, and one 5-cylinder; each housed in a separate building located at strategic points in the area to be served.

Rating conservatively 45, 60, and 75 hp. respectively at 720 rpm., they are ideal for irrigation service—compact, dependable, low-cost operation, trouble-free. From personal inspection this appears to be one of the most efficiently planned and constructively operated pumping plants in Southern California. Much of the credit belongs to Mr. B. F. Anderson, superintendent for the company.

The Worthingtons are installed on cement foundations, and are equipped with automatic devices for stoppage in case of overheating from excessive temperature increase, or failure of oil circulating system. Intake air is filtered and exhausts are silenced. With their pumping units, they are enclosed in fireproof steel and concrete structures. The pumping units are all of the right-angle, geared-head, deep-well type, some direct drive through flexible couplings, others by means of belts. Wells range from 250 to 650 feet, with pumping levels 50 to 140 feet. Pumping capacity is approximately 48 acre-feet per day.

The big interest, however, in this Mutual water set-up, in addition to the plant itself, is in the analysis of operating costs—electric versus gas engine—and the cleverly conceived liquidation plan of engine contract: \$17,000, for 315 hp.

To get a base line to work from, it was decided to take the average year of 1932 as a basis. In fact it was a below-average year, but they were playing safe. Very safe, because the first year of operation under the new setup, the gas cost was \$3,500 against \$9,617 for the base year's electric bill; a saving of \$6,117—1/3 of the engines' cost: 2/3 of the former power cost.

Surprised, and how, because, you see, the basis of payment on contract was that the difference in annual power cost was to be applied on the debt. In other words, the gas bill was to be paid first. The difference between that amount and \$9,617, the base year's electric bill, was the payment on account.

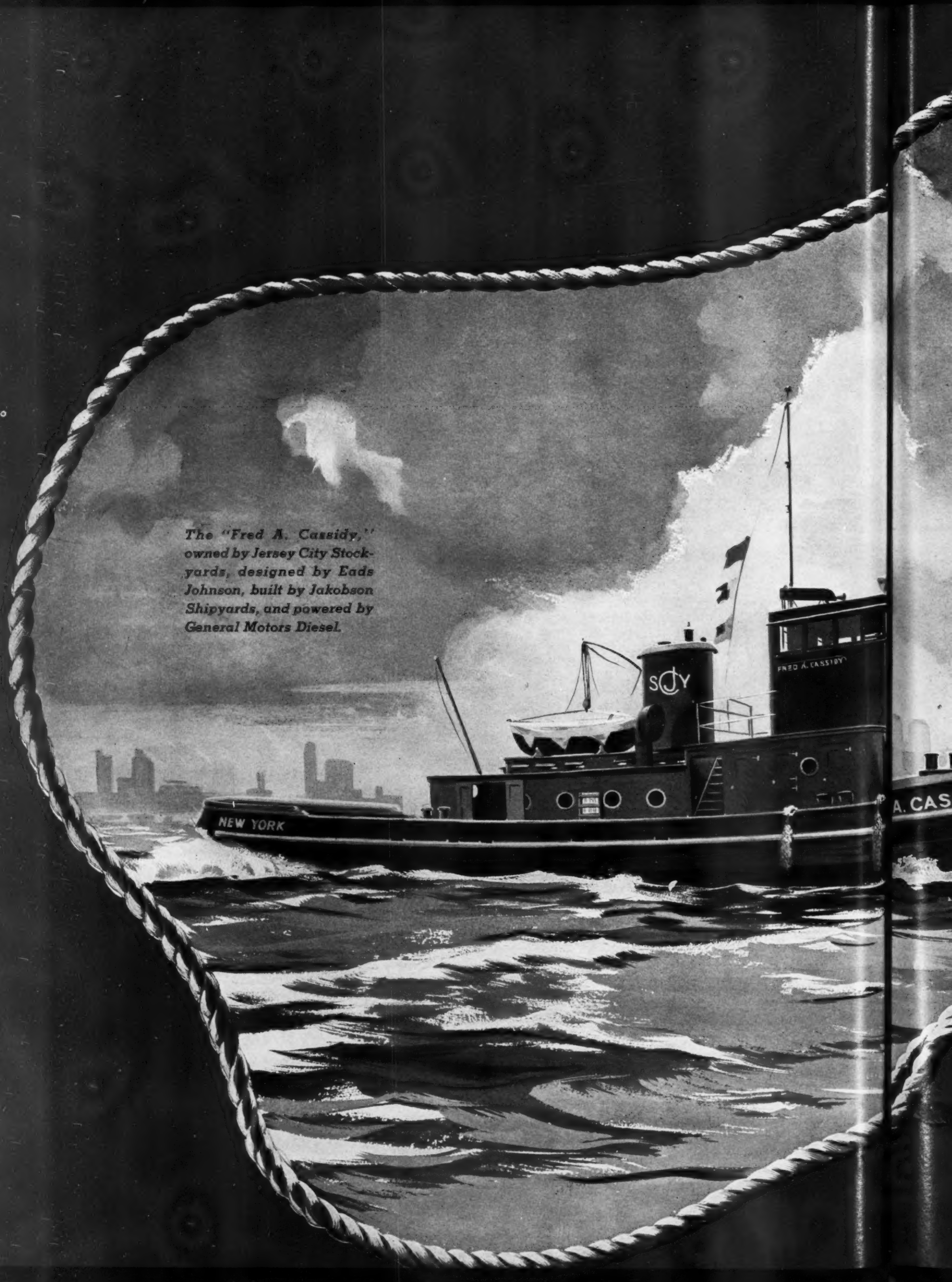
Here was something not figured on, because according to all calculations, even the most optimistic at figures, five years was considerated the minimum payoff, and so the contract stated. But strange as it may sound, the dry years that followed were like the moth in the Scotchman's pocketbook—they were saving years. The more water pumped, the more money saved.

It cost 9.01 cents a miner's inch to pump by electric power in 1931. Ten years later, 1941, it was down to 3.04 cents. But that isn't all—not by a long shot. Get this: In the month of August, 1942, 3,198,600 cu. ft. of gas was consumed. The net cost was \$725.00, an average cost of 22.66 cents per M cu. ft. as the discounts are figured on quantity used. And that pumped 33,496 miner's inches (301,464 gallon) at a cost of 2.16 cents per inch per day.

And the gas rate is on a sliding scale, too: the more used the more saved. Starting at 50 cents per thousand cu. ft. for the first 100,000, it drops 5 cents each 100,000 until the half million mark; thereafter, it is 24 cents. But that isn't all. There are discounts. They start at 7 per cent at \$175 and, at the \$1,000 mark, it's 20 per cent; over \$1,000, it's 22 per cent. All this means that at the average consumption for this seven-engine Worthington powered plant, average fuel cost is 22.7 cents per M cu. ft. in summer; slightly higher other months of operation. Lube oil is purchased at 68 cents a gallon, giving out 1,340 hph. per gallon; gas consumption is 10½ cu. ft. per hph.

Distribution lines consist of forty miles of 12 to 34 inch pipe, some steel, some concrete. And this distribution system delivers six miner's inches per month to each shareholder for each share of stock held. They are sold at the rate of one to the acre held. The holder may cancel any day, or take more another day. And if he requires more water than his shares rate him, he may purchase additional at scheduled rates.

Thus the Mutual Water Company demonstrates the good business principals of cooperative farming. It also demonstrates the economic worth of gas-Diesel engines in irrigation districts. Equipment in addition to the seven Worthington gas engines, includes: Pickering governors; Worthington air compressors, pumps; lube oil filters are Luber-Finer and Purolator; magnetos are by Bendix; Air filters by Vortox; flexible connections are Fast; lube oil pressure controlled by Pressurtrol.



The "Fred A. Cassidy," owned by Jersey City Stockyards, designed by Eads Johnson, built by Jakobson Shipyards, and powered by General Motors Diesel.

COW HAND
for New York Harbor

This "cow hand" works for the Jersey City Stockyards. And true to the trade, has to be quick, agile, reliable.


Pilot house showing remote engine control at the left of wheel.

So taking a leaf from the logs of hundreds of commercial and naval vessels, the owners of this busy tug had her powered with a General Motors Diesel.

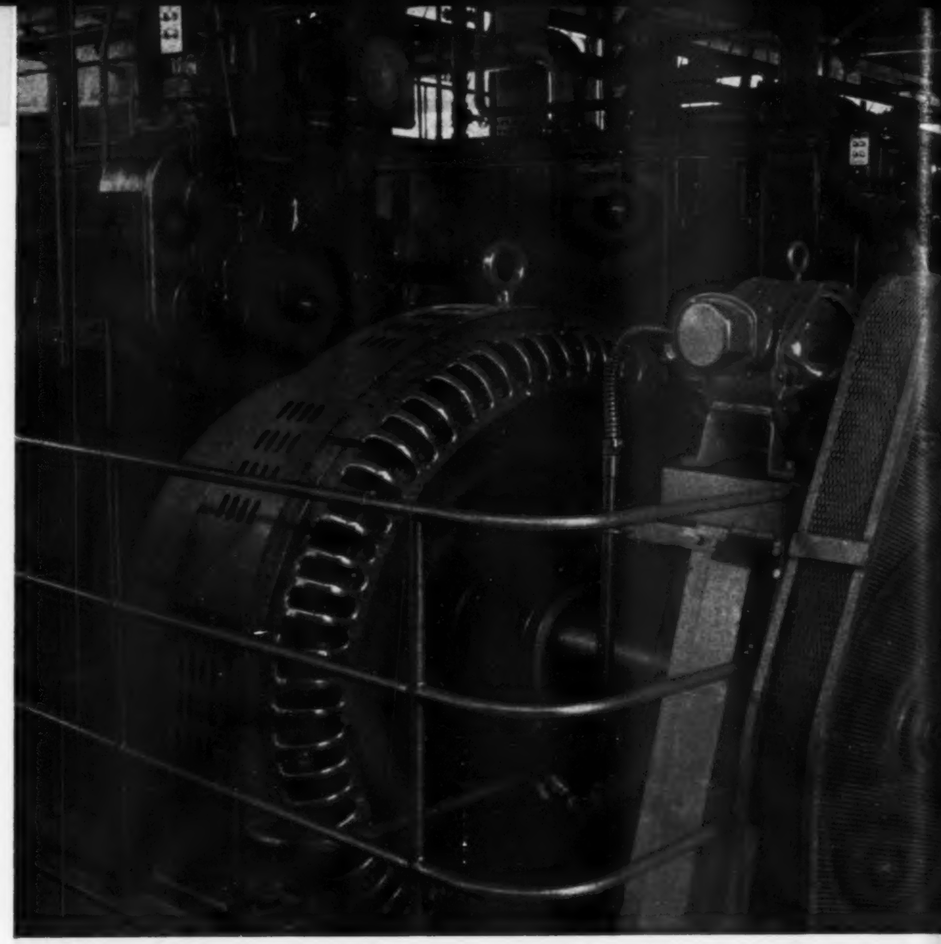
CLEVELAND DIESEL ENGINE DIVISION
General Motors Corporation

GENERAL MOTORS
DIESEL

MORE than 1,000,000 installed Diesel and gas engine horsepower supplies energy for oil-gathering stations, main pump stations, oil treating plants, natural-gasoline plants, stores and camps—turning out the sundry essential products of this vital national industry. Included in this figure is the 3,000 hp. 2,000 kw. gas engine generating North Belridge plant of the Belridge Oil Company in the San Joaquin Valley, twelve miles from McKittrick, Calif. Probably the largest of its kind in any Western oil field, this completely "Micromax" controlled central generating station, the first with this feature erected in any oil field, has as principal features provisions for insuring continuous operation, a radiator cooling system, safety devices for protection of the gas engine-generator units, and the wide range in flexibility available to meet varying load conditions. The compactness of the carefully engineered plant is notable, meeting all requirements since it began in 1940.

The Belridge Oil Company is in the excellent position of being completely free of any outside control, owning its water supply, producing its own crude oil and gas which is processed in the modern company-owned refinery and marketed by one of the major retailers, and having an already installed field distribution system into which it was necessary only to tie-in the new power plant. The chief reason for the company's decision to generate its own electric energy after purchasing it for so many years was its inability to dispose of surplus field gas. But Belridge is an oldtimer in the petroleum field and before undertaking the change-over, with its expenditure of an estimated $200,000, the engineering staff went into plant design thoroughly. Since the station was to supply power to a long-producing field that was in a settled stage of production, costs were held to a minimum. Further, and consistent with this company's carefully worked out economical policy, an estimate was made of the field's probable life and the amount of recoverable oil in the underground pool for assurance that the plant cost was justified.

This decided upon, the plant was designed to generate 2,000 kw., utilizing five 600 hp. gas engines as prime movers. As a precaution against any possible shortage of gas during the field's later years, the chosen engines are Type JS Cooper-Bessemer gas-Diesel units noted for their dependable economy in operation and long life. Turning 400 rpm. to deliver their rated 600 hp., these 8 cylinder engines of 13 in. bore and 16 in. stroke are direct connected to 400 kw., 2,400 volt, 60 cycle a.c. generators with multiple-belted high-speed exciters that respond



Five Cooper-Bessemer gas Diesels of 3000 total hp. and Westinghouse generators in the Belridge Oil Company's North Belridge, California, plant. Note Woodward governors. Right: Operating ends of the engines showing Alnor pyrometers and De Luxe lube oil filters.

rapidly to the voltage regulators. These exciters are mounted on top of the outboard bearing of the shaft extension.

The Type JS engine was also selected because it can readily be converted from natural gas to oil fuel without changing pistons or liners should conditions warrant such a changeover. The cylinder liners are of Meehanite metal known for its strength, excellent uniformity, and freedom from flaws. It is an exclusive feature of Cooper-Bessemer engines. The engines are equipped with a thermocouple for each cylinder, located in the drilled and tapped holes in the exhaust mainfold, directly at the outlet of each cylinder, all of which are wired to an 8-pt. exhaust pyrometer mounted on the engine.

Starting is by air at 250 pounds, ignition is by high-tension rotary magneto; governor is of the centrifugal, hydromatic, spring-balanced type; and gauge board is equipped with the usual air and oil gauges.

Following the latest accepted cooling practice where water is scarce, Belridge has installed a bank of five combination water and oil circulating radiators, each equipped with a constant-speed motor-driven 9-foot fan giving a capacity of 100,000 cu. ft. of air. Under individual thermostatic control, these units automatically cut in and out according to load requirements, maintaining an average oil temperature of 129 degrees and water at 140 degrees, with atmospheric temperatures as high as 117 degrees.

These radiator cooling units are in two sections, the upper for engine jacket water, the lower for lube oil with a minimum pressure of 21 pounds at the heat exchanger inlet. Operating in conjunction with the dual radiators are three tall, small-diameter storage tanks: one for water, the other two for oil. Unit control instead of shutters for radiator control was selected because of saving in power costs, and operating wear. With unit control only, radiators actually needed are on the line, whereas with shutter control, all the units are in constant operation. Temperature of the lube oil is held at 128-130 degrees into engine, 140 degrees to radiators. Jacket water is maintained at 156-160 degrees. Motor driven by-pass valves automatically control temperature of by-pass water between inlet and outlet to avoid sudden drop or rise in temperature as fans cut in and out. An inhibitor is used in the circulating water to prevent oxidization in equipment. The lube oil is reclaimed by means of a centrifugal reconditioner.

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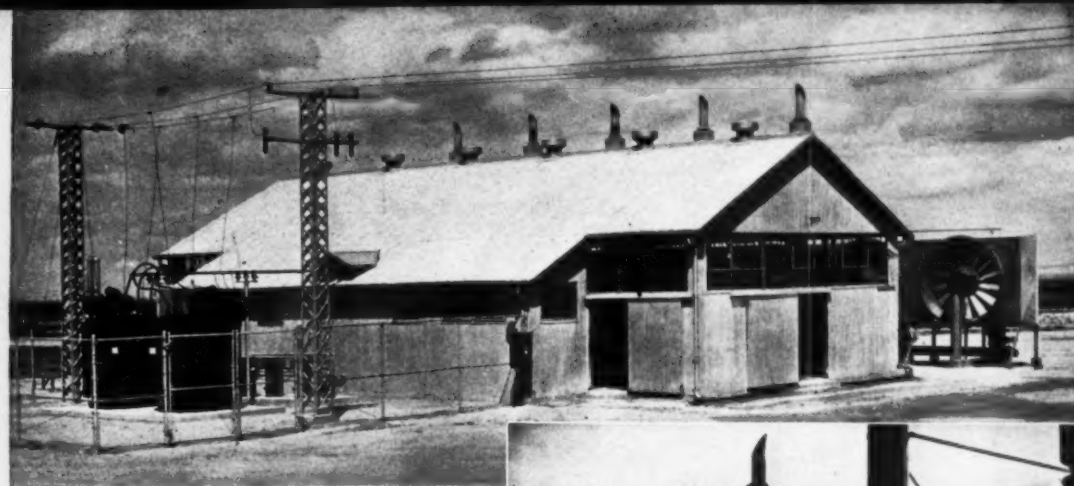
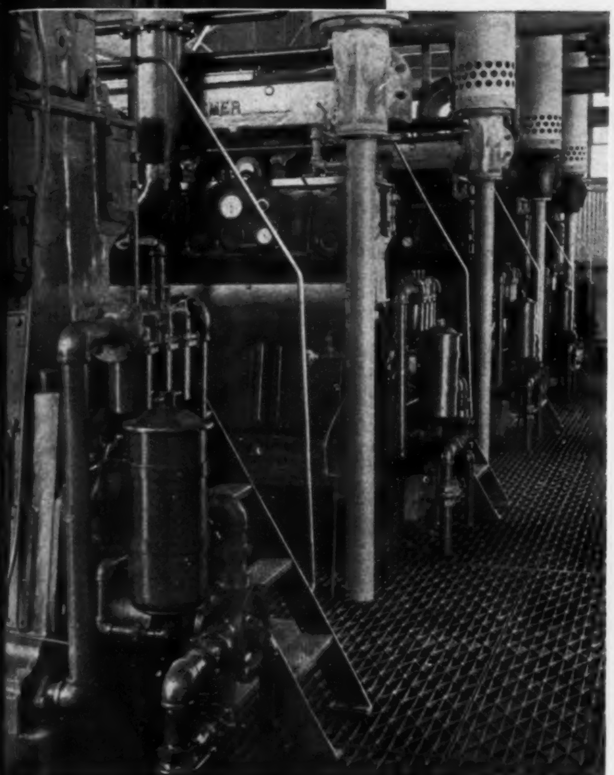
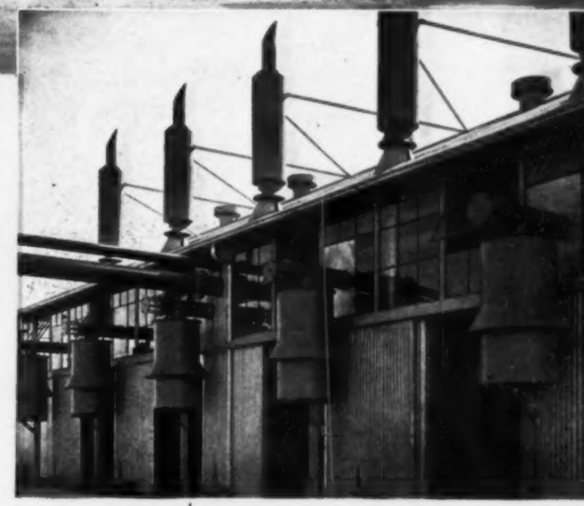


Exterior view of the power house showing transformer station and one of the Flexible engine cooling radiators.





In this view are seen the five American Cycoil intake air cleaners and Maxim exhaust silencers.

FULL AUTOMATIC GAS ENGINE GENERATING PLANT

By JIM MEDFORD

From the generators, underground conduits carry current to the main switchboard; from there it is passed on to the two transformers in an adjacent enclosure where it is stepped up to 11,000 volts and distributed over main and feeder lines to plant and field motors. Other voltages are created according to power demands by separate transformers located at scene of requirements—both motor and lighting requirements for refinery, field, etc.

Automatic frequency controllers with the necessary indicating recorders have been installed on the main switchboard to meet and control the heavy surge-load of the 600 hp. pulling motors. These instruments, besides giving a graphic record of the regulation which is being obtained, are equipped with contacts for automatically disconnecting the control in case of emergency when the frequency exceeds predetermined limits due to uncontrolled outside influences where it is desirable to return the station to normal governor operation.

Selector switches, to select the unit which is to operate as master and to trip and reset switches with indicating lights, are provided. The entire automatic control can be removed from service by operating the trip switch, or returned to service by operation of the reset switch. Each installation is also protected against voltage failure. In the event of such failure, the automatic control is disconnected until the voltage is again restored and the reset switch is operated by hand.

This is understood to be the first automatic installation of its kind in any oilfield—something of which the Belridge people, engine and equipment suppliers, and installing engineers are definitely proud. Its operation will be keenly watched by all concerned.

Plant equipment, in addition to the five Cooper-Bessemer gas engines, includes generators and main switchboard by Westinghouse; automatic frequency controllers by Leeds and Northrup; governors by Woodward; air compressor and motor by Ingersoll-Rand and General Electric; lube oil filters are De Luxe; lube oil is reclaimed by Sharples; lube oil and jacket water cooled by Industrial Engineers cooling units; auxiliary lighting plant by Cooper-Bessemer; Allis-Chalmers "Texrope" drive on exciters; intake air cleaned by American Cycoil filters; exhaust silencers by Maxim; exhaust pyrometers are Alnor; valves by Crane; gauges and thermometers by U. S., American and Weston; piston rings are American Hammered; lube oil pressure alarms are Fulton-Sylphon.

NOTEWORTHY and recent of the Pacific Coast boat conversions was the transformation of the former passenger and cargo steamer *Mohawk* into a powerful ocean-going Diesel tug, now renamed the *Paula*. The *Mohawk*, 97 feet long, 149 tons net, was built in 1921 and operated in the waters of the Puget Sound and Columbia River. The Marine strike of 1934 laid her up until 1939 when she was again placed in service as a general cargo boat making twice-a-week trips between Portland and The Dalles, Oregon. She was acquired in 1941 by Captain A. Leppaluoto of the Upper Columbia River Towing Company and turned over to L. H. Coolidge, Seattle naval archiect who was commissioned to draw plans for the conversion job. His instructions were to "design and equip the *Paula* especially for ocean towing, with economy of operation as key note."

The name *Paula* was dedicated to the five-year-old daughter of Captain Sam Geer, the boat's master who has a noteworthy reputation in the Pacific Northwest. Rebuilding operations took place at the Klepp Marine Ways, Ranier, Oregon. The former *Mohawk's* entire two-story superstructure was cut down to the main deck. The hull was strengthened and bulkheaded for the placing of powerful propulsion and auxiliary units, and a modern two-deck towboat house was erected.

The *Paula* is powered by an eight-cylinder Enterprise supercharged Diesel engine, 12 inch bore by 15 inch stroke, rated at 1,325 hp.

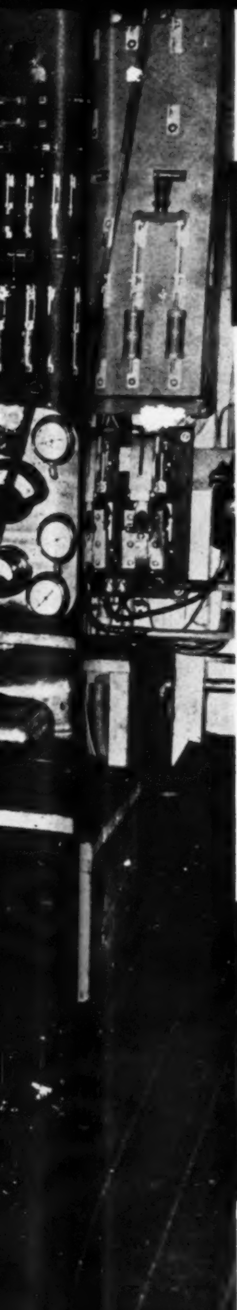
Auxiliary equipment includes two Diesel generator sets, one 15 kw., the other 25 kw., which are used for lighting and auxiliary electric power. With the exception of the Enterprise Diesel, the craft is an all-electric plant. Electric steering equipment was designed and installed by Marine Electric Co. of Portland.

An interesting phase of the *Paula's* operating apparatus is that the electric towing engine and electric anchor winch were entirely designed, developed and built by Captain Geer and his own crew. Other equipment includes a Photo-Electric Pilot; Fisher direction finder; Northern Radiophone; large Cunningham disc type horn and a 19-inch carbon arc spotlight; an Enterprise Pilot House control for remote control of main engine; an Alnor pyrometer for main engine exhaust temperature indication; and Weston tachometers in engine room and pilot house.

The *Paula's* pilot house is most modernly equipped with dual controls and other apparatus. On the same deck is the master's stateroom with two beds. The forward portion of the main deck is divided into two staterooms with berths for two men each. Directly adjoining these staterooms is a specially designed galley, with a modern electric refrigerator and an oil burning range. Many built-in fixtures provide for compact service including a table seating six persons at a time.

The engine room is located amidship, providing a large, free-working deck with the towing equipment aft. Fuel is stored in four tanks with a total capacity of 18,000 gallons. Fresh water tanks hold 5,000 gallons. Additional features include an electrically heated hot water tank, with two shower rooms provided by a Gardner-Denver electrically driven air compressor, and Crane sanitary equipment and fresh water pumps. An extraordinary feature of the *Paula* is that she is superbly equipped to make repairs while away from her base. She carries electric arc welding equipment with 150-foot leads that permit welding work on steel barges.

Past performance of Enterprise supercharged Diesel engines with the Upper Columbia Towing Company fleet influenced the selection of another big Enterprise Diesel to repower the *Paula*. The main object of the conversion of the *Paula* was to produce a powerful and economical ocean-going towboat to tow steel barges between the Columbia River and California, hauling deckloads of lumber South and petroleum products North, with The Dalles, Oregon, as her Northwestern terminus.



Left: Upper engine room view in the "Paula" showing switchboard, gaugeboard with Weston tachometer and Alnor pyrometer, and top of Enterprise, 1325 hp. main Diesel. Right: Pilot house of the "Paula." Below: The eleven-year-old "Paula" on trials after conversion to Diesel.

AN OLD TIMER CONVERTED

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GREAT

SPRAWLING from the head of Lake Superior and from St. Paul-Minneapolis across the northernmost part of the boundary states of Minnesota, North Dakota, Montana, Idaho, and Washington, the Great Northern Railway reaches across the western part of the United States to within 200 miles of San Francisco. Every operating problem to be found on this Continent may be found on the far-flung web of tracks operated by the Great Northern, and its flock of subsidiaries, many of which extend far north into Canada.

Their last annual report to pleased stockholders and employees, beside showing a property in unusually good condition, a modest, low-interest, long-maturity funded debt, a nice sum available for dividends, showed also that this railroad, in spite of its huge length, operated 813 steam locomotives; 49 Diesel and 15 electric locomotives in 1941.

Since the Empire Builder himself gathered 'round him one of the greatest staffs of mechanical engineering and civil engineering brains ever under the banner of a railroad, to lay the groundwork for that famed short-cut rail and water route to Asia, the Great Northern tradition has been a mixture of extreme caution and daring innovation that periodically explodes with huge, bold engineering projects financed with cash out of the G.N. coffers. The Wenatchee-Skykomish A.C. electrification; the eight mile New Cascade Tunnel; the California extension, etc., are examples which have made American Railroad history.

The advent of practical Diesel motive-power for railroad use hit the G.N. at a time when it had just completed electrification of a 200 mile mountain section in Washington State, displacing some forty-five steam locomotives, and found itself with a surplus of smaller, lighter passenger and branchline freight power due to heavy curtailment of train-miles during the latter Twenties and early Thirties; at a time when highway and air travel were making heavy inroads and the evolving of a special type of the largest size Mallet steam power, a whole series of which were built in the company shops at Hillyard, near Spokane, each of which displaced from two to four lighter locomotives; and, lastly, due to demand for heavier and faster mainline passenger power, a whole new fleet of high speed, heavy oil burners for the main trunkline operation. In other words, the Great Northern had a surplus of motive power when Diesels began their brilliant showing. First, came the Diesel switchers, now almost a standard replacement item in the 600-1,000 horsepower series throughout the system. Over forty of these are now on their daily grind at various G.N. terminals.

Naturally, the G.N. did not leap into the Diesel mainline power picture at the start. Cautiously avoiding Diesel streamliners in the early experimental stage, in a territory already over-loaded with railroad competition, the G.N. waited until it found definite spots within the system where Diesel could replace steam outright, and quickly displace the accoutrements of steam operation such as fuel, water and repair facilities, smoke nuisance, replacement of rail with heavier weights for newer steam power, replacing bridges and roundhouse facilities.

With a cold calculating eye to sound engineering, Great Northern suddenly threw out electrification on its Spokane, Coeur D'Alene and Palouse subsidiary last winter—the "Uphill and Downhill" line reported in DIESEL PROGRESS this past summer. Now three Diesel locomotives do the work of thirteen electrics on that 165 mile system.

Next, it began casting around for spots where the principal asset of Diesel motive power—high daily operating factor—would fit into the general scheme.

The Mechanical and Operating Departments of this company have always been closely allied with the right-of-way or Civil Engineering Department, so to speak, an item which is not true of many railroads. Just because some division or mechanical superintendent thinks a Diesel would be fine in a certain spot, it does not always follow that the General Manager's office with a cold eye for roadbed, depreciation, and replacement cost will always go along. Diesel does not replace steam on the G.N. just because they need a new steam engine. Usually the extraneous factors involved outweigh the need for mechanical replacement. As a result of this Managerial Attitude, the Great Northern, in 1940, ordered its first mainline Diesel from General Motors. They would have no "truck" with Diesel for heavy passenger runs, simply because they already had a magnificent fleet of steamers, relatively new and good for many years of service.

But they quickly took up Diesel freight engines and have already given them three of the most spectacular workouts ever recorded in motive power history and, at this writing, report continued records, high earning power, low operating costs, and long spells between overhauls on all three of their experimental installations.

The following is an analysis of the three mainline G.N. jobs the Diesels are doing—a bit different, a bit more thoroughly and obviously more successful than one may find on almost any other system. It must be kept in mind that these Diesels were specifically designed to do a definite job, rather than just dumped into the power pool to be used wherever handy or to replace a broken down locomotive for a short time only. All four of them have started their routine in a certain spot and are destined perhaps to remain for their entire life.

Generally, they have displaced steam 100% and have been fitted into the whole economy of that area to replace, besides investment in displaced steam power, heavy investment in modernization of facilities, generally in amounts equal or greater than the value of the locomotives they displaced.

The lowest crossing of the Continental Divide in the U.S.A. is operated by the Great Northern at Glacier Park, where its famous Marias Pass crossing goes over the hill at 5213 ft. elevation. Only 55 miles of the G.N. crossing of the Continental Divide is above 4,000 ft. elevation, and but three ordinary freight train lengths each side of the Summit lie above 5,000 ft. elevation.

ORTHERN

GIVES ITS DIESELS *DAILY BREAKDOWN TESTS*

By CHAS. F. A. MANN

Westbound, the line ascends the Summit at Glacier Park so gradually that an ordinary heavy locomotive will drag 100 cars at schedule speeds. Eastbound, after a long, gentle water grade climb that begins just outside Spokane with a down-dip at Troy, Montana, the line reaches Walton, east of Whitefish. A single G.N.-built simple Mallet will haul a 5,000 ton freight train clear into the Rockies from Spokane to Walton. From there it is a 1.8% grade for eighteen miles to Summit, the only helper division of any consequence on the whole G.N. transcontinental line, except in the electrified non-helper zone over Cascade Range.

For this service, from one to three steam locomotives were formerly required to haul freight and passenger trains up the Big Hill. Because of total lack of helper service east of the summit, the procedure has always been to cut out the helper at the top of the hill and back eighteen miles down to Walton. Double tracking the approach and the hill has improved operation and speeded movements, but not eliminated the costly layovers of a steam engine in cold Montana winters. The passenger trains required a faster, high wheel helper in order to maintain schedules, while heavy Mallets were cut into the freight trains.

A General Motors three-unit Diesel, first of its type ever built, was designed for this special helper duty. It consists of three cabs, each with a V type 2 cycle GM Diesel, having 16 cylinders and rated at 1320 hp. Each of the cabs rides on two four-wheel trucks, each with a geared traction motor for each pair of drive wheels.

Unlike the regular GM freight unit, these units are geared down to a maximum of 45 miles per hour speed, with a 12-65 ratio and, when coupled together as a helper locomotive, will produce a maximum of 165,757 lbs. tractive effort at 25% adhesion or better than 110,000 lbs. continuous tractive effort when travelling at twelve miles per hour.

The outer ends of units 1 and 3 have conventional operating cabs, replete with extra large heaters, foot warmers, windshield wipers, etc.; soft seats for the crew, and ample sound insulation. The operating requirements are such that the Diesels run wide open in position 8 all the way uphill, which is not easy on the ears. A very small Vapor heating boiler is fitted in the middle unit only for warming jacket water and cab heating during layovers or in the 45 below zero weather that sometimes strikes the Continental Divide in winter.

The machine develops 4050 Diesel horsepower, but, due to the tractive effort curves as between Diesel and steam, it shows up a maximum of 165,757 lbs. tractive effort, with all wheels sanded and going uphill, as against only 146,000 lbs. maximum tractive effort for the big Mallet steam engines it replaced. No steam locomotive on the Great Northern will equal the maximum tractive effort of this three-unit Diesel. Hence its suitability for mountain helper service in all kinds of weather.

In practical operation, the new Diesel has broken so many records that it is becoming almost unfair to compare it to the former steam helper service. To start with, no turning is necessary at each end of the run. The Diesel will haul from four to eight freights eastbound daily, in addition to two heavy passenger trains, one at twelve miles per hour and the other at thirty. Water tanks now only serve the mainline power. A roundhouse at Walton has virtually become disused because the mainline engines go straight through to Blackfoot.

Let's go out "On Line" and watch how it functions, earning back its original investment every eleven months, and saving hundreds of dollars weekly in direct operating costs. Second

No. 402 East, with 4750 tons has just pulled out of Whitefish with 82 loads and nine empties, in charge of Conductor Webster. The long drag up the canyon behind No. 2045, the biggest G.N. Mallet, is negotiated at about twenty miles per hour and the Glacier Park scenery beyond Belton keeps the eyes occupied. We never see the Mallet from the time we leave Belton until we reach Walton, where the Diesel is cut in about two-thirds of the way back in the train. Air tested and the Diesel cut in, we leave the caboose and ride the Diesel and listen to it perform with the throttle wide open, all twenty-four driving wheels continuously sanded, and the main Diesels turning up at slightly over 800 rpm. Going uphill with a heavy load, the direct-connected traction motor cooling blowers show their sound merit, for they are operating at maximum output when the greatest cooling effect is needed in the motors, and in the radiators atop the cab roof.

Piston cooling oil holds steady at 21 lbs. pressure and the main bearings steady at 31-28-25 pounds in the three locomotive units. Deft handling of the shutters by the veteran "fireman" keeps the water temperature even, no matter what the side-wind velocity or the outside temperature may be. Not a single hot engine alarm sounded, and only twice did the wheel slip indicator flash all the way up. As the crew says, "Probably the engineer spit on the rails," at these times. Nearly half the total capacity for wheel-sand is used in a single eighteen mile trip, so heavy and steady is the pull. So long as the train keeps close to twelve miles per hour speed, no trouble is to be had from the unequal pull of the steam locomotive when teamed up to the steady flow of power from the Diesel. Cutting the Diesel back far enough in the 3/4 mile long train keeps this worry at a minimum, and no drawbars get yanked out or air hoses broken. The Diesel acts against a 60% pusher load and 40% pulling or trailing load in this manner, and sudden wheel slipping from the pulling engine at the head end does not stall the Diesel nor spin the wheels. Careful teamwork in icy weather, from long practice, gives the Diesel engineer the cue to cut down quickly. He merely watches the speedometer and quickly cuts down on his throttle when a sudden one-two-three mile drop in speed appears. Almost uncanny, this operation of a freight train, with the main engine lost in the night far ahead around perhaps a dozen curves, and the Diesel helper working steadily behind.

Helper crews, the highest paid train crews on any railroad, like the even warmth of the Diesel cabs in the frigid Glacier Park winters.

Locomotive toilet facilities found on a Diesel here, above every other place, find a friendly reception in a vast, trackless mountain wilderness where outdoor toilets are the rule, not the exception. Refueling is done in series, for the Diesel makes a round trip in approximately 2½ hours, pulling 1¾ hours uphill, and coasting downhill with periodic dead stops for safety in about 3/4 hour. Plans are soon to install regenerative electric braking so that the big machine can coast all the way downhill at 35 miles per hour, saving both time and brake shoes. Sometimes the Eastbound freights come so close together that the Diesel operates almost continuously, resulting in a schedule of refueling one and sometimes two of the three units each day to save time on a full re-fuel operation. The Diesel is turned around once each ten days to equalize wheel wear. During its first six months' operation, it ran continuously without ever shuting down the Diesels, then dashed down to Whitefish for the compulsory I.C.C. locomotive inspection!! Not that it needed inspection, but the Law says Diesels, like their jittery steam brothers, need inspection every six months.

In March, 1942, for example, it made 167 round trips to the summit. Each unit consumes, on an average uphill trip with a 5,000 ton load, 125 gallons of fuel oil, or 375 gallons per trip. Keep in mind a 5,000 ton freight train is a big one, and the G.N. was the very first American railroad to operate a whole transcontinental system with 5,000 ton freights —due to its favorable grades. This Diesel gets the most gruelling test, daily, of any freight Diesel in service on any railroad. Position 8 is used all the way up, and the transition lever in position 1, so she runs to the limit of adhesion constantly.

On this particular trip your Correspondent left Walton at 9:20 P.M. arriving at Summit at 10:45; leaving Summit at 11:05, and back to Walton at 11:50. To illustrate vividly the typical night grind, the Diesel again left Walton as helper to 1st No. 460, with 88 cars and 4,900 tons (they deliberately hit 5,000 tons or almost, by filling up trains to this load limit at Whitefish Yards before starting Eastbound on all trains), at 12:20 A.M., arriving at Summit at 1:45 A.M. and leaving Summit at 1:55 A.M., back to Walton by 2:45 A.M. Second No. 460 with 81 loads and 4,900 tons left Walton at 4:20 A.M.; arriving at Summit at 5:50 A.M. and the Diesel left Summit at 6:00 A.M. and back to Walton at 7 A.M. What, no rest? Not on your life! Extra 5900 West with 44 loads and 41 empties, 3585 tons, left Walton with the Diesel at 7:35 and arrived in Whitefish at 9:45 A.M., leaving its steam engine at Walton to substitute as helper during the Diesel locomotive's absence!

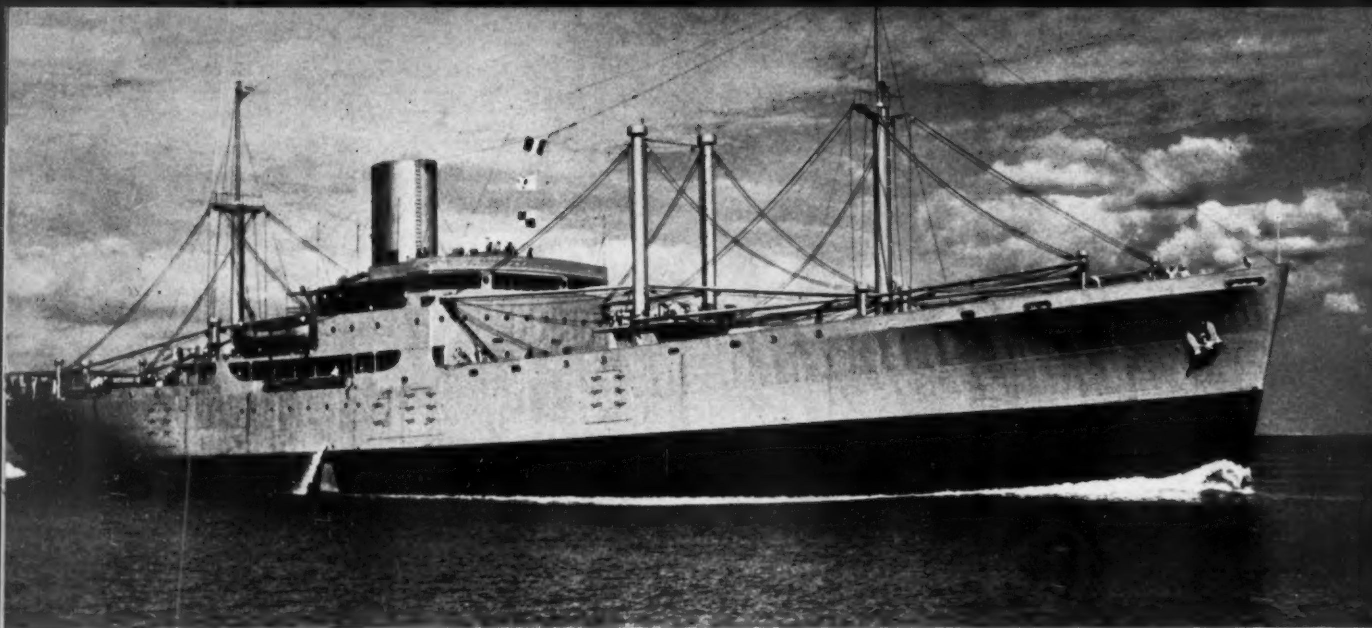
And so it goes—day in and out, weeks and months at a time. No Diesel locomotive ever put to work in America receives the breakdown, gruelling test that this helper service at Glacier Park gives it. The results add another chapter to railroad history and it is but a question of time until all other railroads follow the Great Northern's lead.

General Motors 4050 hp. [illegible] three unit Diesel locomotive cut into a 5000 ton eastbound freight train near Glacier Park, Montana, between Walton and Summit.

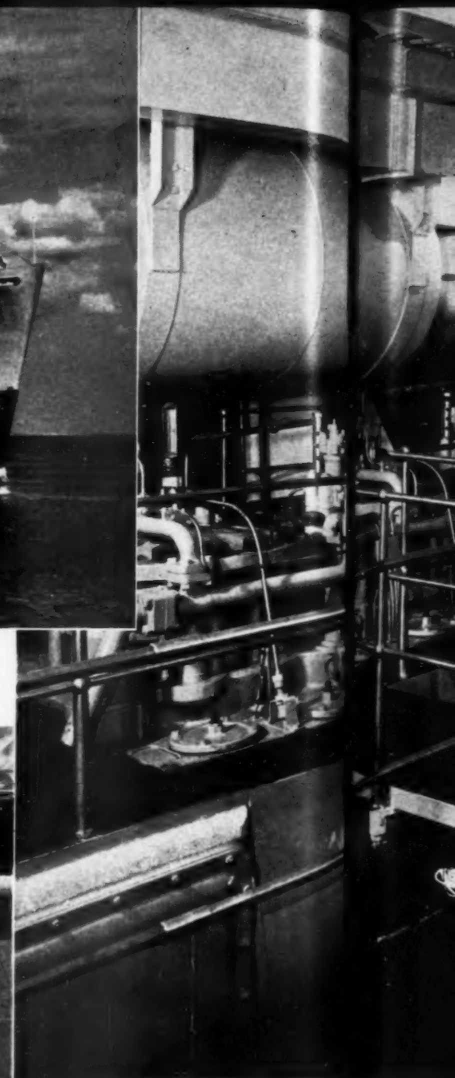
DIESEL STANDBY FOR RADIO STATION

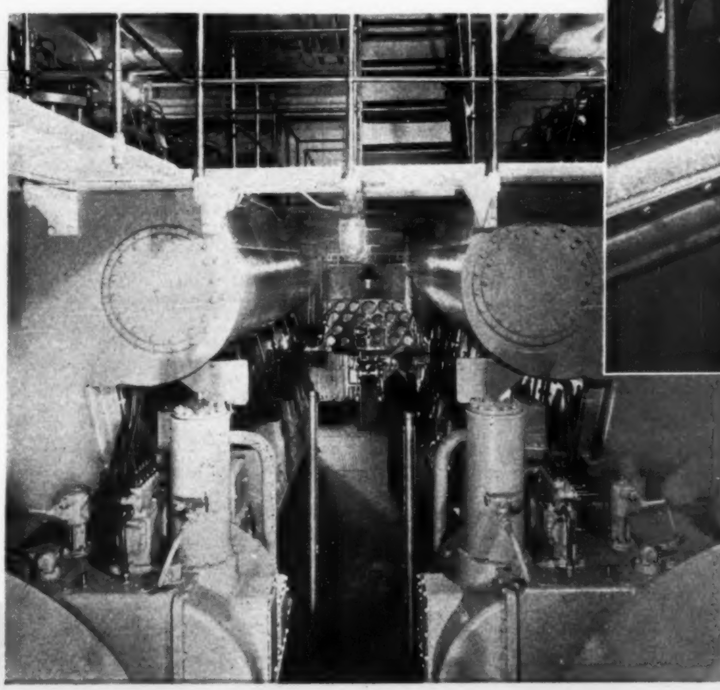
Left: Victor Voss, Chief Engineer, in transmitting room of station WIND, Gary, Indiana. Center: The Diesel generating set used as standby power for transmitter and lights. Below: Exterior view of the station.

RADIO Station WIND of Gary, Indiana, a 5,000-watter, is using Diesel generating set as a standby source for its transmitter and lights these days when it is more important than ever before that radio stations give uninterrupted service. Last February a Caterpillar Diesel-electric set was installed by Station WIND and, according to Victor Voss, Chief Engineer, is proving very satisfactory.



"Mormacdale," a Diesel freighter embodying the excellent features of the U. S. Maritime Commission's C1 design.





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A FINE DIESEL FREIGHTER

By DOUGLAS SHEARING

THE *Mormacdale,* a Maritime Commission C1 class ship completed early this year, was the largest vessel yet turned out by Pennsylvania Shipyard, Inc., at Beaumont, Texas; in fact, the largest ever built in the State of Texas. Powered by a pair of Nordberg Diesels driving through Westinghouse electro-magnetic couplings and reduction gear to a single propeller shaft, she attained speeds in excess of guarantee during two days' successful sea trials.

At 23½ ft. draft, the *Mormacdale* displaces 11,000 tons and her light displacement is 3,670 tons. She is 412 ft. 3 in. long, overall, and her depth, moulded, to shelter deck is 37 ft. 6 in. Present conditions render it inadvisable to publish further dimensions or to mention the rating of her engines. She is, however, one of many similar types of vessels for which Nordberg has supplied the main propulsion Diesels. These engines are arranged to burn heavy fuel, a feature which will render the operating cost per horsepower delivered at the shaft considerably lower than that of Diesels burning higher grades of fuels. The *Mormacdale* Diesels are each six cylinder, two cycle, direct reversible and each engine and its electric coupling are so arranged that they can be maneuvered either singly or in parallel with the other engine.

It is noteworthy that there is a power loss of only 3½ per cent in the electric couplings and reduction gear. This type of marine drive is rapidly gaining favor in this country not only because installations already made have given good account of themselves but also because they permit a wider selection of available engines and allow the ship designer more latitude in space arrangement. Smaller, high speed engine units may be employed, thus reducing machinery space to the benefit of cargo space.

Nordberg supplied a central control of its own design by which both engines and couplings may be maneuvered from a point just forward of the main engines. This mechanism provides control of the engines in the four following categories: 1. Both engines coupled to the propeller shaft
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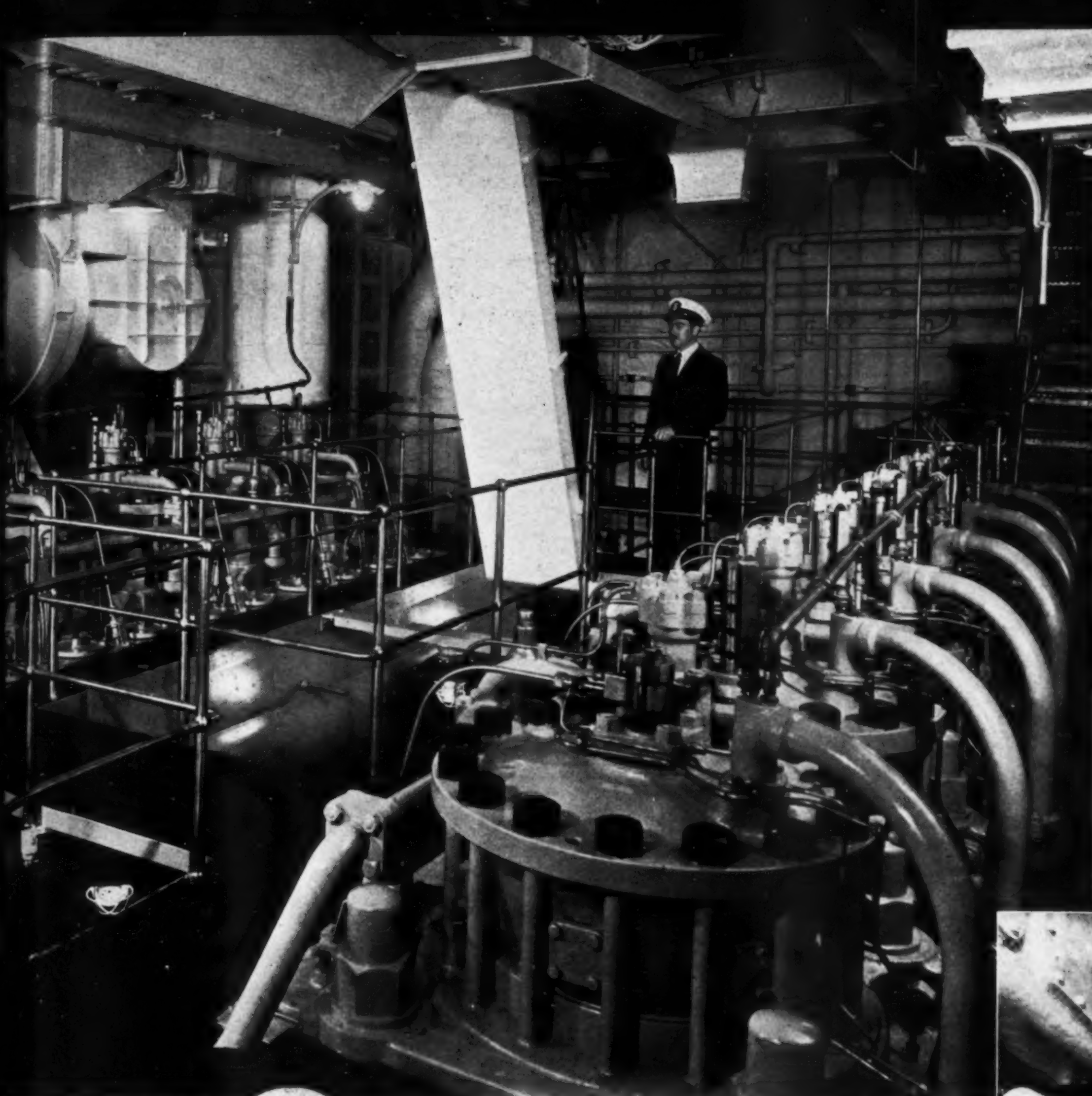
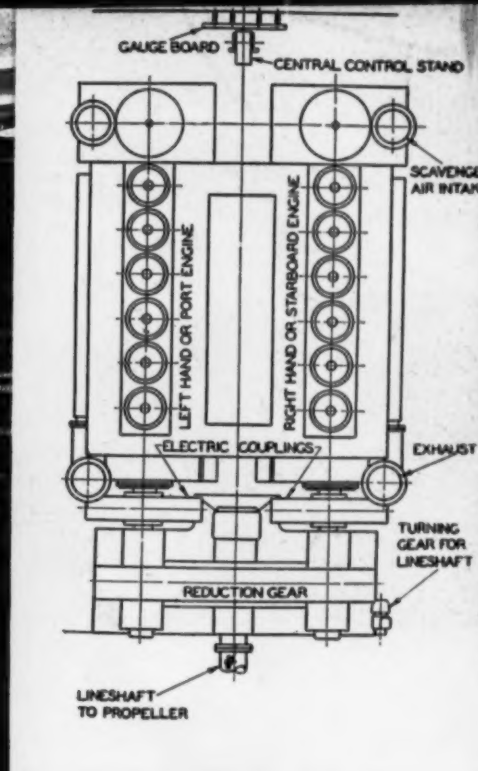




Layout of engine, electro-magnetic coupling and reduction gear arrangement.

Left: View between the two Nordberg main Diesels, looking forward. Note central control stand and gauge panel center. Above: Upper engine room view. Right: View looking aft between the Nordberg Diesels.

peller shaft running ahead or astern. 2. One engine coupled to the propeller shaft running ahead or astern. 3. Both engines operating, but in opposite directions for rapid reversal of the propeller shaft. 4. Crash stop and reverse.

Every inch a modern freighter, the *Mormacdale* is equipped for rapid handling of cargo, her Nos. 1, 3, 4, and 5 hatches being each served by two winches and boom and No. 2 hatch having four five-ton booms and winches also one thirty-ton boom. Her decks are unusually clear of obstructions. All padeyes, cleats, and miscellaneous equipment are kept close to the sides and hatch coamings. The forward winches are placed inside the line of hatches, the group serving hatches Nos. 2 and 3 are located atop the resistor house and the winches between No. 1 and 2 hatches and between No. 4 and 5 hatches are similarly located. Two sampson posts carry the booms between No. 2 and 3 hatches. The light booms are served by ten single-geared winches while the heavy lift boom is served by two double-geared winches.

She is of the flush-deck type with the brake water fitted between the anchor windlass and No. 1 hatch. The shelter deck space is fitted with large side ports which permit the loading of large cargo units directly onto the shelter deck. An extra side port is provided on each side for taking on fuel oil and fresh water. These side ports will also serve as convenient gangway entrances. The shelter deck space also houses the ship's hospital, refrigerated stores, galley, fire extinguishing equipment, and the crew's mess and laundry. The captain's quarters are located on the top deck just aft the wheel house. On the next deck below are deck officers' and chief engineer's accommodations for eight passengers and dining saloon and lounge. The crew; that is, the unlicensed personnel and assistant engineers, are quartered just above the shelter decks on the first deck in the superstructure.

The *Mormacdale* is a functionally designed ship, especially well fitted to serve her country.

Extreme left: V. C. Genn, Sales Manager, Detroit Diesel Engine Division, General Motors Corp. Next: View of the tank engine section of the school. In the background, men are seen installing Diesels in medium tank hulls. Above: Army mechanics solve Diesel problems with the G.M. Maintenance Manual.

DETROIT DIESEL SCHOOL *for Soldier Mechanics*

AN intensive training [illegible] whereby soldier-mechanics are [illegible] how to service and repair Diesel [illegible] equipment at the front line[illegible] graduating men at the rate of 40 [illegible] week. The school, which is operated by the Detroit Diesel Engine Division of General Motors and the GM Institute of Technology [illegible] Flint, Michigan, already has graduated more than 300 soldier-mechanics and 40 new enrollees are accepted each week.

[illegible] the program of the school, V. C. Genn, of Detroit Diesel, [illegible] out that success [illegible] rations in the Libyan [illegible] a large degree to an efficient [illegible] on-the-spot repairs of machines which had been knocked out of action. The GM Diesel school, with which the U. S. Army Ordnance Department is cooperating closely, similarly is training soldiers to make field repairs of damaged equipment.

The three-week training course at the school comprises 144 hours of intensive study. Classes continue eight hours per day from Monday through Saturday. At least eight weeks of basic mechanical training at an Army training center are required to qualify a man for the Diesel course. Each Monday morning the forty new enrollees are divided into two groups. Sixteen of them are assigned to instruction in service and operation of GM Diesel engines [illegible] are used in landing boats, and twenty-four are trained on the Diesel [illegible] used in U. S. medium tanks. [illegible] than 10% of the time is allotted to classroom lectures and discussion, [illegible] over 90% is spent in actual disassembly and reassembly or operating of the complete engine and its component parts. Students receive their training on exactly the same engines which they will be required to operate and repair on the firing line.

The first week of the course is spent by the soldier-students in tearing down and rebuilding either tank or amphibian Diesel engines including actual running on a test stand. During the second week, the students study, repair, and adjust the engine sub-assemblies, including blower, injector, and fuel pumps. The third week is allotted to a study of gear boxes by the Amphibian Engine group and to operation of twin engines in actual medium tank hulls by the tank group.

A complete Instructor's [illegible]ual is used by all the instructors [illegible] basis for conducting their classes. [illegible] manual is divided into six main [illegible]tions—Instructor's Outline, Instructor's Laboratory Outline, Job Sheets, Instructor's Demonstration Outline, Examination Sheets and Equipment Lists. In addition, each student works with a set of job sheets which act as a guide in the various phases of his training.

At the end of each week the student is required to pass an examination with a minimum grade of 70 per cent in order to progress to the next week's work. A final examination is taken by all students at the end of the third week.

Active in the operation of this comprehensive training course are Major Albert Sobey, M. L. Gilbert of the General Motors Institute of Technology; Capt. William M. Reno of the U. S. Army Ordnance Department; V. C. Genn, Sales Manager, and August Brecht, Service Manager, of the Detroit Diesel Engine Division. According to Mr. Genn, many graduates of the school are now in active service in the operation of Diesel amphibian and tank engines on our wide spread fronts.

Exchange Your Diesel Maintenance Ideas

Conducted by R. L. GREGORY

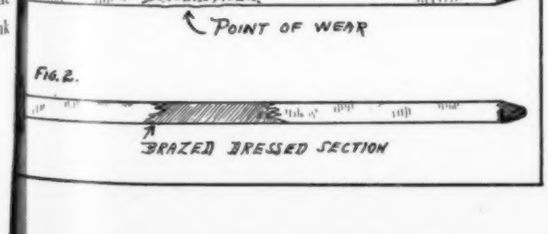
Editor's Note: In this department we provide a meeting place where Diesel and Gas engine operators may exchange mutually helpful maintenance experiences to keep our engines in top condition. Mr. Gregory edits your material and adds constructive suggestions from his own wide experience. This is your department —mail your contributions direct to DIESEL PROGRESS.

Wear of Needle Valves on Fuel Valve Mechanism

UNDOUBTEDLY many of our readers have experienced trouble with excessive wearing of the needle valves on the fuel valve mechanism at the point of contact with the valve packing. Mr. Ernest Didier of Osage City, Kansas, has submitted the following method, which he has adopted to prolong the life of these valves.

"We have experienced difficulty in our air injection Diesels, with excessive wear on the needle valves at the point where the valve rod passes through the packing. When this condition is found, the rod is placed in a lathe and a light cut taken off the pitted or worn section as shown in Fig. 1. This cut does not have to be exactly true and may be uneven. We then made a jig from two pieces of angle iron, leaving a small space in the center so that the work can be rotated and the part which had been machined out was refilled by brazing. In so applying this brazing, care must be taken to avoid overheating and warping, a small amount of brazing being applied at a time and the work rotated until enough brazing has been applied to the rod so that it can be machined true.

"The rod is then placed in the lathe and turned to proper size. We often notice, however, small pin holes where air bubbles have formed. We clean these holes out and, after tinning, fill with solder and polish with fine emery cloth. We have found that needle valves repaired in this manner give four to six times more wear and less trouble than new needle valves, since we have a good brass surface for the packing to make contact with consequently less tightening on the packing gland and longer life to the packing. The finished job is shown in Fig. 2."



The writer might suggest that Mr. Didier can eliminate the necessity of soldering up the pin holes by eliminating them in the brazing. These pin or air holes are caused by the flux used, and if care is taken in brazing up the rod to remove particles of flux which adhere to the work before applying more brazing, these air holes will be almost entirely eliminated.

Another way to take care of this trouble is also suggested. The life of a needle valve can be greatly prolonged by removing the needle valve at frequent intervals, placing it in a lathe, using center and chuck, and using a grinder. In this manner, a smooth job is obtained and a very few thousandths ground off will make but little difference on the diameter of the rod which will not be harmful and will give a tight smooth surface at the point of contact with the packing.

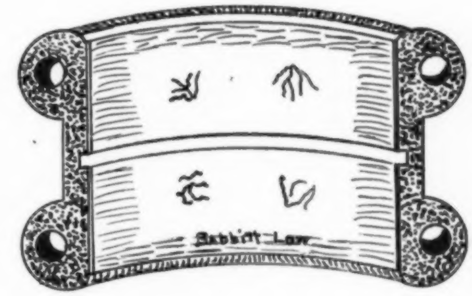
Securing Longer Life from Engine Bearings

ONE of our readers recently wrote us his experience on the above subject. His letter is as follows:

"Over a period of many years, we have been trying to figure a way to get more service and longer life from the connecting rod bearings on our units. It seems that when we pull our pistons and overhaul the engines, which is done about every 2000 hours of operation, we find bearings that have to be replaced due to cracking of the babbitt. We finally worked out the following system:

"Our maintenance schedule was changed so that we could inspect the connecting rod bearings approximately after every 800 hours of operation, keeping a record and sketches of the bearings and showing the condition of the babbitt on each bearing. We discovered that in most cases, the babbitt was cracking as shown in the accompanying illustration, and not always in the same place, the checks varying as to position.

"We then experimented with these bearings, trying to eliminate the growth of these cracks, and found the solution by scraping the babbitt around the cracks, making these spots about .003" lower than the rest of the bearing surface. After several attempts and inspections, the cracks would remain without further growth, and the bearings operated cooler. We concluded that the cause for these cracks was excessive heat at this particular point of contact with the shaft, causing undue expansion at this point and eventually causing it to crack.



"We have also found spots where the babbitt did not adhere properly to the shell when poured, and the bearing would show cracks at these points. We used the same method of scraping at these points to keep the bearing cooler.

"By this method, we have increased the time for pulling the bearings to 1000 hours, never over, and are very careful to keep these cracked spots scraped lower than the surrounding surface. We are very careful in adjusting the clearances to obtain the least clearance possible and still have our bearings move from side to side. We have found that if we cannot feel any up and down clearance, the bearings will run properly so long as they move from side to side.

"Due to this close inspection and care, we have doubled the hours of life on our bearings, and our continuous record of these bearings has helped us a lot in our maintenance work."

This department is glad to receive experiences such as the above and wishes to pass them on to our readers. While the writer of the above has discovered a method of securing longer life to the bearings on his units, we believe that the article which will appear in the December issue of DIESEL PROGRESS will be of great help to him in further alleviating his troubles.

Bearings are an all important subject, as there are so many differing factors affecting their life.

CONVERTIBLE DIESEL-GAS COMPRESSOR EN

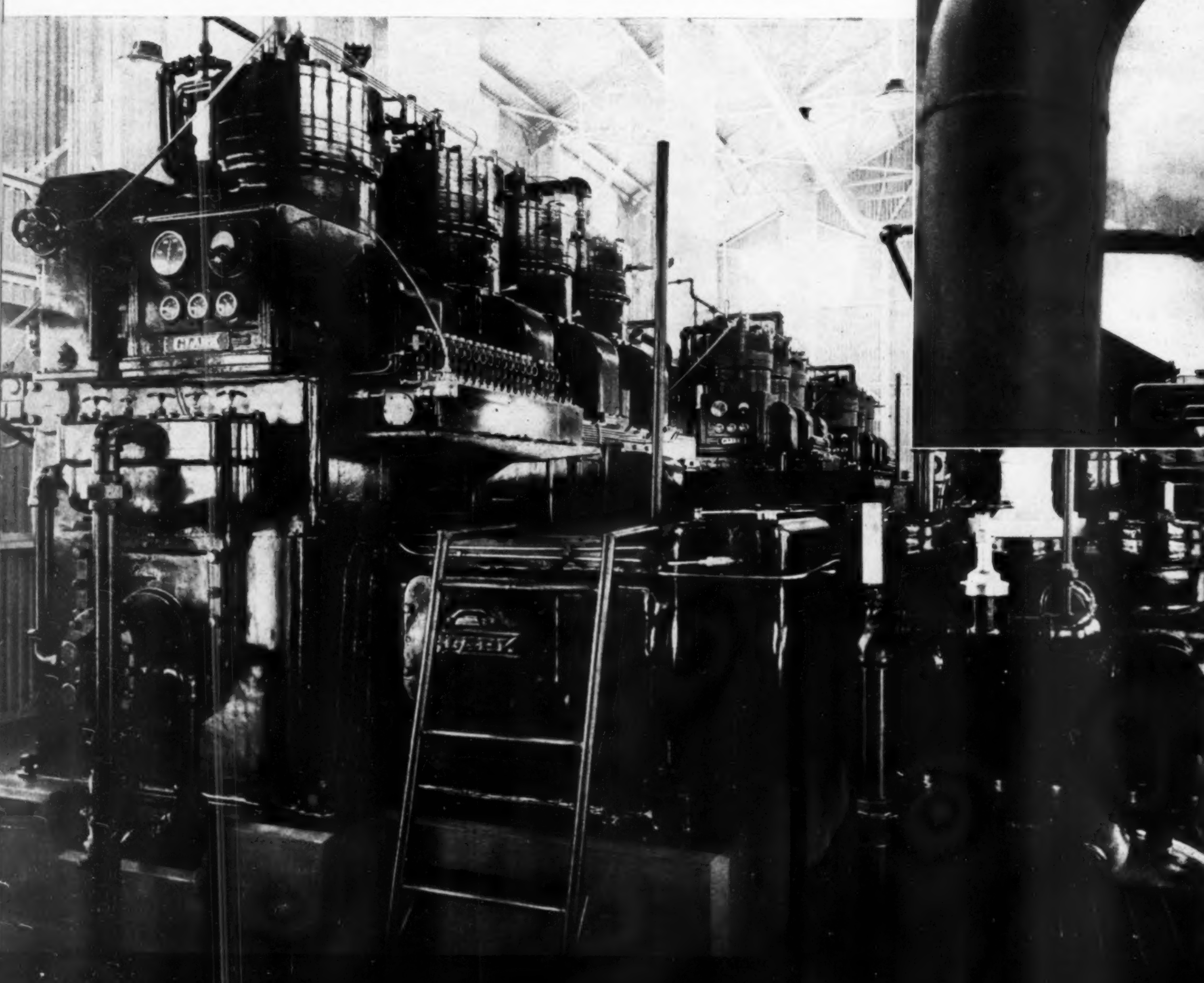
At Luby, Texas

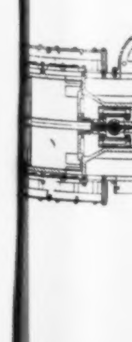
By WM. H. GOTTLIEB

OIL field operators were among the first to recognize and utilize the advantages of the natural gas internal-combustion engine, and continuous improvements in engine design have kept this type of equipment in the forefront as a power producer wherever the fuel is obtainable. The convertible Diesel-gas engine introduces an element of flexibility which further enhances the value of these units. It was natural, then, when one of the major oil producers erected a gasoline plant in the Luby Field, Texas, in 1939, that it should choose the most modern, efficient power units for the major work of compressing the gas from which gasoline was to be stripped. For this continuous, heavy-duty service the engineers installed three of the new gas engine, angle-compressor units. Two of these Clark compressors have three power cylinders each, and each set of power cylinders drives two, 24 by 14-in. compressor cylinders. The third engine has four power cylinders driving two, 24 by 14-in. compressor cylinders and one 7 by 14-in. recompressor cylinder. Each power cylinder is rated at 100-hp. at 200 rpm. The power cylinders are in line vertically and this vertical gas engine drives horizontal compressors connected to the same crankshaft. This compact arrangement makes for easy installation, simple maintenance and a high overall efficiency.

All the gas that enters the plant, 9,000,000 cu. ft. a day, is handled by the compressors. Coming in from the wells through two, 16-in. main gathering lines, the gas passes through a scrubber for removal of distillate and reaches the compressor intake through lines from a 20 in. overhead header just outside the power house. The gas comes to the compressors at a 7 in. vacuum and is discharged at 45 lbs. pressure into a common 20 in. line in a concrete box outside the plant. After passing through the coils of one section of a large atmospheric-type cooling tower, the gas reaches an absorber where lean oil takes from the gas the gasoline it carries. The denuded gas flows out through a residue line from which the supply of engine

Below: Three Clark angle compressors with a total horsepower of 1,000 supply all power for compressing gas at a gasoline stripping plant in the southwest. Right: Intake gas line leading into scrubber through which may be seen the absorber, still, and stabilizer.





ENGINES

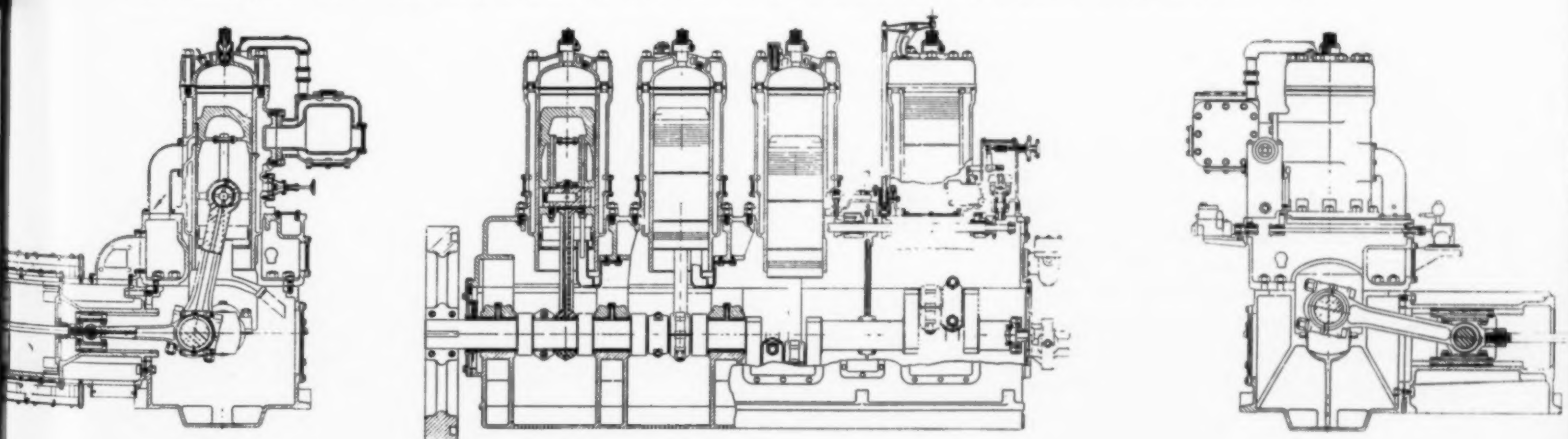
fuel is drawn. Besides supplying the engines, gas is used for boiler fuel and for domestic use in the camp, and the remainder is burned by two waste flares. From the absorber the rich oil enters the still where hydrocarbons are flashed off and the denuded oil returned, through heat exchangers and cooling tower, to the lean oil suction. From the outlet oil line of the main still, a quarter inch line draws part of the oil to a small still heated by steam and electricity where the lighter portions of the absorption oil are flashed off and the heavy substances discharged to the sewer. In the course of operations, this cleans the entire absorption oil supply. Vapors from the main still are condensed in a battery of coolers and returned to an overhead tank. The refluxing medium for the still is taken from this tank and the balance of the liquid is fed to the stabilizer. All excess gas is returned to the power house where the recompressor raises its pressure from an inlet of 25 lbs. to a discharge pressure of 175 lbs. The higher pressure keeps the lighter hydrocarbons in fluid which enters the stabilizer at the top charge line. Vapors from the stabilizer are cooled and returned to a tank which supplied refluxing medium for the stabilizer while the rest passes to the butane storage tank where it is weathered to 70 lbs. pressure and sold as commercial butane. Gasoline leaving the stabilizer is cooled and stored in the five 30,000 gal. storage tanks for delivery by pipeline to refinery.

Gas in the residue line is kept at 28 lbs. but a regulator reduces pressure of the engine fuel supply to about 16 lbs. At this pressure the gas enters the power cylinder through a fuel injection valve just as the piston, moving upward, has closed the intake and exhaust ports. Thus, there is no loss of gas. The mixed air and gas charge is compressed until finally ignited by the magneto system. Effective scavenging of the cylinders is insured by a double acting air pump driven from the crankshaft of each engine. This scavenging cylinder pumps air into a manifold within the crankcase at about 3½ lbs. pressure. As the piston nears the exhaust ports, burnt gases are allowed to escape and pressure to drop to atmospheric. Then the air inlet ports are uncovered and scavenging air at 3½ lbs. pressure rushes into the cylinder in such a manner that it sweeps out all exhaust gas and charges the cylinder with fresh combustion air. Air for each engine is cleaned in an oil-bath type filter located outside the plant before reaching the scavenging pump. The hot exhaust gases exit through a water-cooled header which leads to a vertical silencer extending up through the roof.

All bearings are lubricated by a pressure system. A gear pump driven from the crankshaft takes oil from the crankcase and puts it through a duplex filter, a cooler, and then into a header within the crankcase. From the header the lubricant flows under pressure to the main bearings, then up the drilled connecting rods to the wrist pint bearings. The same oil is forced up into the piston crown to serve as a cooling agent, returning through a downspout to the base of the crankcase for recirculation through the lubricating system. Both power and compressor cylinders are lubricated by a force feed mechanical lubricator which supplies oil to three points on the perimeter of each cylinder. In addition, each engine is equipped with a one-shot lubricator serving the fuel injection valves. It is the practice at this plant to drain the crankcase once a year, putting in a fresh supply of new oil. Only water obtained from condensing exhaust steam is used in the closed cooling system. The soft water flows by gravity from a surge tank to the suction of two 650 gal. per minute centrifugal pumps which send it through coils in the large cooling tower, then through the engine jackets back to the tank. Two 2000 gal. per minute centrifugal pumps put raw water over the tower. Even the raw water is treated to protect coils, pumps, and spray nozzles. Makeup for the raw water supply and water for use in the camp is drawn from a well by a centrifugal well pump driven through right-angle gears by natural gas engine. The gas engines are protected against injury through failure of cooling water or lube oil pumps. If the water pump discharge pressure drops 25 lbs., a whistle sounds, warning the operator. If no action is taken and the pressure drops down to 10 lbs., the magnetos are grounded, stopping the engines. There are also switches arranged to ground the magnetos if lube oil pressure drops below 15 lbs. or if engine speed rises above 325 rpm. A gauge board on each engine holds an exhaust pyrometer, a tachometer, thermometers and pressure gauges. Engines are started by compressed air and each power cylinder is equipped with a starting valve. Air is supplied by a two-stage, locomotive-type, steam-driven compressor.

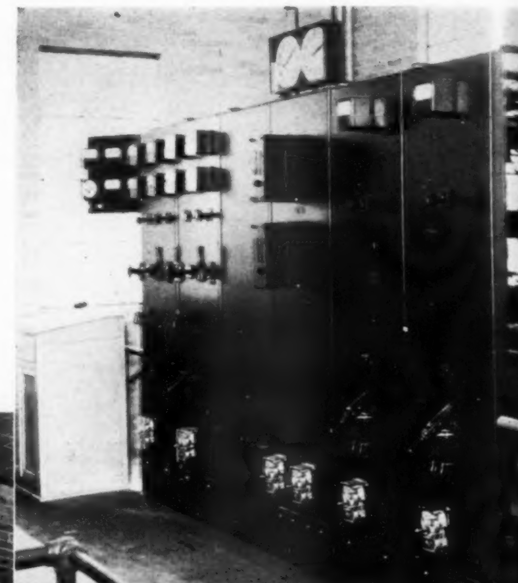
Oil field operation is frequently a continuous and arduous service for a power plant. This 1000-hp. engine compressor plant was designed to handle 9,000,000 cu. ft. of gas each 24 hours but the load has been known to go as high as 10,500,000 cu. ft. In the entire life of the plant there have been no enforced shutdowns and no repairs whatsoever. Once a year each engine is given a thorough inspection. At the latest check, there was no noticeable wear in either cylinders or bearings. In this plant at present, there is no incentive to economize on fuel since any saving in engine consumption would only need to be burned by the waste flares. Yet, the increasing utilization of waste products someday may make it advisable to conserve the fuel supply and the company may then have the full advantage of economical engine operation.

Below: Cross-sectional views of four-cylinder Clark gas engines used in the compressor plant; vertical natural gas engines drive horizontal compressors, power transmission being obtained by the connection of compressor and engine pistons to the same crankshaft.

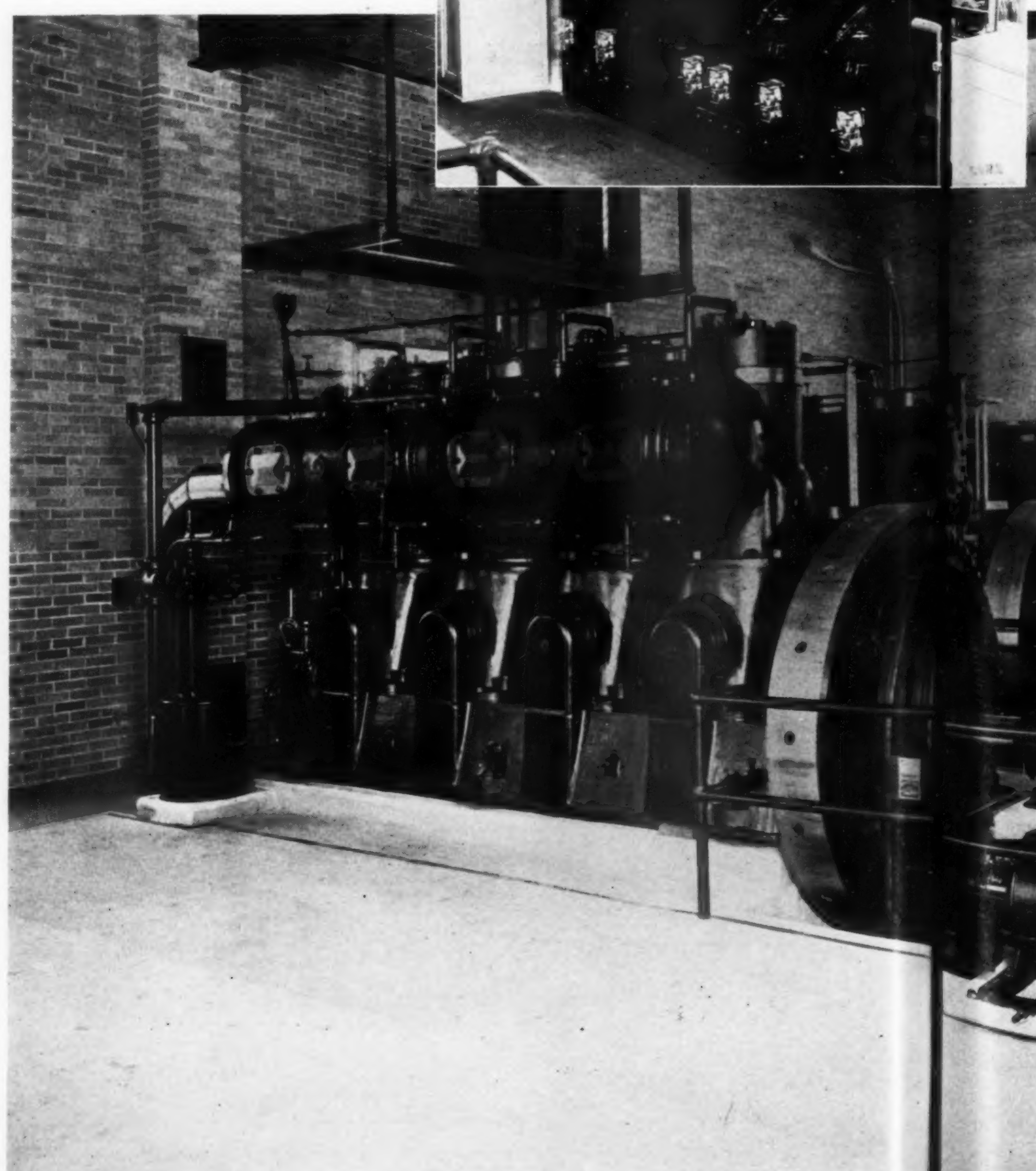


CASCADE, IOWA, ACCUMULATES CUSTOMERS

By GEORGE COLDEWEY



The modern dead-front switchboard with totalizing swing panels is shown at the left.



THE town of Cascade, Iowa, operating its home-owned light and power plant has steadily accumulated customers throughout the first two years of operation, which fact has enabled them to keep ahead of their ambitious amortization schedule. A steady growth in the number of consumers and the quantity of kwh. sold has borne out the predictions of the Mayor and Council, and the consulting engineers, the Stanley Engineering Co.

Various civic organizations in Cascade were among the group which first became interested in considering ways and means of acquiring a municipally owned light and power plant, recognizing that such a plant, properly operated, would be of financial benefit to the town as a whole. On the evening of May 20, 1938, the Mayor and Council, the Business News Association, and certain members of the local American Legion Post met in an open meeting to consider such means.

Developments took shape rapidly, and the important steps were under way for furnishing this town of 1300 people with their own plant to replace the public utility service. By December of 1938, the Stanley Engineering Co. of Muscatine, Iowa, had been retained as consulting engineers, and all plans and specifications were completed.

A PWA grant was successfully solicited and bids were received and opened on December 26, 1938. The bidding resulted in awards to Fairbanks, Morse & Co. of Chicago for two 300 hp. heavy duty Diesel generating units with accessory equipment and to L. A. Kepp of Rochester, Minnesota, covering the plant building, switchgear, and distribution system, totalling approximately $100,000.

Despite injunction proceedings instituted by the utility company, which litigation was carried to and through the Supreme Court of the State of Iowa, construction of the new plant was started in December of 1939. Construction including the installation of the generating equipment was completed in July of 1940, when successful operation began.

The Fairbanks-Morse units are each rated at 300 hp. at 300 rpm. They are both two cycle full Diesel engines each driving a Fairbanks-Morse engine type alternator rated 250 kva. at 80% P.F. 3 phase, 60 cycle 2400 volt. Each generator has its own exciter, Morse chain driven from the end of the extension shaft. The air intake supply is filtered through American type SCF filters and the exhaust is

The Cascade, Iowa, municipal is modern and attractively situated.

Main power units are Fairbanks-Morse 4 cylinder, 300 hp. Diesels and F-M 250 kva. generators with Morse chain driven exciters.

silenced by Maxim Type MU silencers mounted in a brick and concrete housing. The air surrounding the silencers is heated from the exhaust and is drawn into the engine room in winter time to supplement the heating plant.

Woodward governors keep the frequency correct, as well as determining which unit will take the swings. Switchgear of modern design, and built by L. A. Kepp, controls the units and distributes the current as shown by the photograph. The engines are started by compressed air, stored in air tanks from the Diesel Plant Specialties Co. who also furnished the gauge and alarm panel for temperature and pressure control. An Alnor RB pyrometer is mounted on this gauge panel. Starting air is furnished by a pair of Fairbanks-Morse Type H 1 compressors. One is motor-driven and the other engine-driven.

Engine cooling is accomplished by circulation of jacket water by Fairbanks-Morse motor-driven centrifugal pumps through open coils in the basin of a Marley atmospheric spray cooling tower located behind the plant. Two Graver 12,000 gal. fuel storage tanks also located behind the power plant supply fuel through Struve fuel regulators.

Lubricating oil is refined by an Ames Renuoil Purifier, located in a separate room in the basement of the building where lube oil storage tanks are also located. Quantities of fuel oil and lube oil are measured by Niagara Fuel Meters as furnished by the Buffalo Meter Company.

To simplify maintenance, a five-ton hoist is mounted on an I beam running over each engine, on the engine centerline. Space was provided for a third unit for future expansion of the plant without additional building construction. The building itself is of pleasing appearance, of brick and concrete construction with steel window casements, and it provides ample space for all equipment, office facilities, and garage facilities for the city owned utility service trucks. It blends well with its surroundings being located in a town park on the bank of the Cascades for which the town was named.

Already Cascade has benefited by a rate reduction from rates charged originally by the public utility. In addition, the returns from plant operation, estimated at from $25,000 to $30,000 per year, will soon pay off the indebtedness of the plant and subsequently enable Cascade to continue with its ambitious civic improvement program.

FACTORS GOVERNING THE COST OF DIESEL GENERATED POWER

By R. L. GREGORY*

CONTINUING this article from our October issue, the next cost to be considered is that of lubrication. While this is a comparatively small item when fuel and labor costs are taken into consideration, yet it must be considered in production costs. Here again, no definite figure can be given, since plant conditions, type of equipment, and quality of oil used determine the cost. The cost of lubricants, however, does not vary as do fuel costs, since most vendors have a prety well stabilized cost on equal grades of lubricant. You can pretty well determine, therefore, after a few weeks' operation, what your consumption will be under normal operating conditions, and from that, knowing the cost of the oil you are using, you can determine just about what your lubricating costs should be.

There are always certain miscellaneous costs of supplies and labor which must be figured into plant costs, although they are not directly connected with the production of power. Such costs, as maintenance labor on buildings, filtering of oils, plant cleaning, and upkeep, must enter into your cost figures, since they are necessary to production.

The reliability of your units and equipment figures greatly in power costs. The American Society of Mechanical Engineers has made a survey of the reliability of Diesel engines and it is noteworthy that the Diesel ranks high in this particular phase. In a report made in 1933, the relation of total enforced shutdown time, as compared to total operating time, amounted to 0.0084 per cent. This approximately on 300 units which shows the reliability of the Diesel. Here is something a little more tangible on the operation of a unit for the year 1941:

Total hours of service	4875:04	55.65 %
Total hours of prearranged outage for inspection and overhaul	360:00	4.11 %
Total hours devoted to routine maintenance when unit was not needed	116:35	1.33 %
Total hours of voluntary outage, exclusive of above, when unit was not needed, including Sundays and holidays	3406:21	38.908%
Total time of forced outage due to breakage of compressor valves, unit load being transferred to standby unit, causing no service interruption	2:00	.002%
Total	8760:00 hrs.	100.00 %

* *Chief Engineer, Municipal Water and Light Plant, Hillsdale, Michigan.*

The above figures were taken from the operating log of a 2250 hp. air injection engine, cross head type. While this unit was operated only 55.65 percent of the total time during the year due to load conditions, nevertheless the figure of .002 percent of forced outage compares very favorably and is somewhat better than the average as reported in the survey of The American Society of Mechanical Engineers. The above points cover about all those which apply directly to the costs of power generation. In addition to these, there are certain fixed charges which every plant should make, but which many plants do not consider in the cost of power production, but take out of the gross earnings. These fixed charges cover depreciation, insurance, taxes, sinking funds, insurance and contingency funds.

While it is the usual practice to keep production costs and fixed charges separate, the writer does not agree on this entirely. Insurance should be carried on every piece of equipment in the plant, since no mechanical equipment has ever been developed that is not susceptible to mechanical failure at some time or other, and this failure in ninety-nine percent of the cases is due to fatigue or conditions beyond the control of the personnel.

Hence, insurance should be carried and, as this is a fixed rate based on a definite period of time at so much per $1000.00, this rate should be charged to operating expense and spread out over the duration of the policy as a fixed operating charge.

Another item usually carried as a fixed charge is a contingency fund. As this fund is normally used for plant emergencies and future equipment, a certain percentage of the gross income should be deducted each month and placed in this fund as an operating expense, since it should be used for plant purposes only. Now, many will not agree with me on this point, asking what is the difference whether you take it out of the gross income and set it aside, or whether you charge it to operating expense? My answer to such a question is simply this: If it were charged directly to operating expense, there would not be the temptation, so often carried out, to use the contingent fund for some purpose other than plant development and expense. Ofttimes when other departments are hard pressed to meet conditions outside of the plant, it is easy to tap the contingent plant fund for the necessary wherewithal to carry on. When some emergency occurs or new equipment is desired, the fund has been appropriated elsewhere, and the plant is left holding the well-known "bag." While, therefore, it is merely a bookkeeping proposition were it charged out against production costs, it could not be transferred to another fund.

In summing the matter of costs on power production, by studying the foregoing points engineers can work out a pretty accurate figure of what their costs should be. Of course, these will vary, but whether produced by Diesel, steam, or water, costs usually must be based on conditions as found in the plants in question.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Waukesha-Hesselman Type
Witte Types
Wolverine Diesels
Worthington Diesels
Worthington Gas Engines

DIESEL

AN OUNCE OF PREVENTION .....

Editor's Note:—A noteworthy contribution to the subject of Diesel engine conservation was made in the special October issue of The Sinclair Firebox which we are glad to pass along to the readers of DIESEL PROGRESS in two sections. The following is the first section.

POWER, in all its forms, is one of man's greatest treasures! To those of us whose lives are linked with the production of Power falls the vital responsibility of protecting the engines from which Power derives. In these critical days, power plants, whether stationary or mobile, whether of ten or of a million horsepower, are being taxed to the limit of their capacity.

Throughout the field of Power production, for Industry, Transportation or Communication, operators anxiously seek ways and means of producing more power more efficiently and of making their equipment last longer. Today the need for full power from the Diesel engines in Trucks, Tractors, Boats, Stationary Plants, leads the Diesel Operator to expect the remarkable vitality of his engine to accomplish miracles! And miracles it will accomplish indeed, in efficiency, steady maximum power, and high availability, providing the operator keeps in mind certain "Experience-proven" rules of protective maintenance, and exercises the proper care in selecting and handling his fuel and his lubricant.

These simple rules, easy to apply to a small Diesel engine on a truck as well as to a huge power plant Diesel are summarized herewith.

"Fluid" = "A liquid or gaseous substance capable of flowing." In the operation of a Diesel engine, four fluids are involved: Air, Fuel, Lubricant, Water.

These four fluids flow through the engine, each along a very definite path, each accomplishing a very specific purpose. Every vital part of the Diesel engine is connected with the flow of at least one of these four fluids: the injection system, the combustion chamber, the exhaust, the cooling passages, the lubricating ports and channels, etc., etc.

As long as the flow of these four fluids takes place as intended by the designer of the engine, as long as the quality and the quantity of these fluids are correct and their passage unimpeded, the operation will be satisfactory and efficient, and the mechanical parts will be protected against wear and tear. But let there be any irregularity, any hindrance to the proper flow of either one of these four fluids, and immediately some unpleasantness is liable to occur.

These unpleasant consequences of a failure in the Flow of one of the Four Fluids can be listed somewhat as follows: Loss of Power, Smoke, Noises (Combustion knock, mechanical noises and vibration).

It is, therefore, entirely possible to follow carefully each of the four fluids mentioned, in their flow throughout the Diesel, point out the precautions that must be taken to avoid any failure of the correct flowing process, and, as a consequence, maintain the Diesel engine at the peak of its efficiency and longevity.

The combustion of any fuel burned in suspension calls for certain fundamental requirements which are: (1) Correct proportion of fuel and air; (2) Correct temperature; (3) Correct mixture of fuel and air.

In the Diesel engine, a fixed quantity of air is admitted to the cylinder, and a variable quantity of fuel oil is injected into this air, after compression, according to the load. For instance, at quarter load we may have 40 lbs. of air per pound of fuel, at half load 25 lbs. of air per pound of fuel and at full load we may reach perfect combustion with 14.13 lbs. of air per pound of fuel. Above that proportion our engine would be "Overloaded" and more fuel would be introduced into the combustion chamber than the air could burn; this would result in smoke, carbon formation, its consequent bad effect upon the injection system, and the loss of power that might follow.

Now, if we recall that a pound of cold air occupies 13 cubic feet, we may form an idea of the enormous volume of air necessary for proper operation of the engine.

How can the flow of air be affected?

First of all by the Altitude. The effect of altitude is noticeable principally in the Western part of the country where differences of 7,000 feet in one trip are not uncommon; drivers who notice that the engine lacks power high above sea level frequently tamper with the adjustments of the governor and "limit stop" or "smoke stop" which results in intense smoke when the engine is back to lower levels.

Secondly, by the Temperature. When the weather is very hot, there is a tendency for a deficiency of air. On trucks and buses there seems to be a tendency nowadays to admit air from outside the hood; it is cooler and less contaminated by oil vapors.

Thirdly, by a dirty Air Cleaner. It is absolutely essential that the air cleaner be inspected regularly. In trucks, cleaning of the air filter should be a routine operation at 1,000 or 1,500 miles; 2,000 mile intervals seem to be the maximum admissible. Correct grade of oil in filters of the oil type is important; if oil is too light, it has a tendency to be carried along with the air, and if too heavy, it will hinder the free passage of the air. Obviously, recommendations of each manufacturer should be followed carefully.

Also, by obstructed air passages in the engine itself. Inlet valves must be regularly inspected.

The shape of the air ports in two-cycle engines with superchargers is very important; their clogging seems to be a matter of frequent concern in the automotive type of engine. Frequent inspection of these ports through the removal of inspection plates, and cleaning of these ports by means of a special tool is advocated as a means of decreasing the chances of smoky exhaust.

Finally, by a defective supercharger in an engine equipped with it.

Once the proper flow of air has reached the combustion chamber, it must be mixed properly with the fuel, if combustion is to be completed. Of course, the basic design of the combustion chamber will, to a great extent, determine the efficiency of combustion at various loads. But, regardless of the design, it is essential that the injection system be kept in good shape for correct operation; this will be also treated in the following discussion on the flow of fuel.

As combustion of the air-and-fuel mixture is completed and all the energy available in that mixture has been transferred to the piston and crankshaft of the engine, the burned gases leave the cylinders through the exhaust ports. Here again it is essential that the flow remains unrestricted to avoid excessive back pressures detrimental to good operation. Exhaust valves must be checked periodically to detect signs of burning or sticking.

A check of the temperature of the exhaust gases, as they flow out of each cylinder, will reveal any irregularity in the operation of the cylinder and prompt remedy can be applied.

These recommendations are suggested to offset the **aforesaid conditions:**

1—**Do not overload the Diesel engine;** in particular, **do not tinker with the injection pump and governor adjustments.**
2—**Examine and clean air filter** at frequent, **regular intervals.**
3—**Examine and clean air passages** to the cylinders **at regular intervals.**
4—**Keep supercharger,** if any, in perfect operating **condition.**
5—**Avoid back pressures** in the exhaust pipes.
6—**Check exhaust temperatures** of individual **cylinders at regular intervals** to detect irregularity **in operation.**

Because the original Diesel engine was designed to **burn "pulverized coal"** and because the first **large, slow speed,** Diesels in operation in the **United States burned heavy fuels,** even crude oil, most satisfactorily, the belief spread **among the public that** "a Diesel engine will burn **anything."** In reality, the high speed, moderate size, **Diesel engines of today,** with the extremely fine clearances of a fraction of a thousandth of an inch between parts of their injection system require a scrupulously clean Diesel fuel, free from gum, grit, and especially free from condensed moisture.

It is, **therefore, essential** that unusual precautions be taken to protect the Diesel fuel during its storage and its transfer from the storage tank to the Diesel injection system. **It is true** that all Diesel engines are protected by screens and strainers; these must be inspected at regular intervals, cleaned or replaced according to type. **Nevertheless,** in spite of all these precautions, difficulties can be expected if the fuel is not stored and handled properly.

It is recommended:

First, that the best grade of Diesel fuel be purchased, from a reliable supplier who knows how to avoid contamination.

Secondly, that this fuel be stored in a clean, tight tank, protected against contamination. Also, that the transfer operation from the storage tank to the Diesel or to the service tank be accomplished with extreme care, and that the pump, pipes or hose, funnels and strainers, etc., used in that operation be kept scrupulously clean.

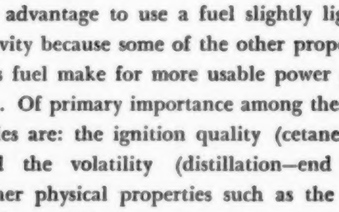
Finally, that the service tank, if any, be equipped with a small valve, at the lowest point, from which a small quantity of fuel can be drained at regular intervals to remove any possible condensation and sediment that may have entered through the vent pipe, especially if operation takes place in a dusty atmosphere. In large power plants where heavy low grade fuel is used, it should be centrifuged and preheated. Check and clean fuel injection system regularly as per manufacturer's recommendation. Do not overload the Diesel engine and, in particular, do not tinker with the injection pump and governor adjustment. No lugging.

Following the flow of Diesel fuel through the engine, the very heart of the Diesel is reached: its fuel injection system, and remember that the essential conditions for proper combustion, mentioned already, are a correct proportion of fuel and air, a correct mixture of these two fluids and a correct temperature. Factors which may affect the flow of fuel and its proper mixture to the air are:

1. Worn injection pumps or injection nozzles.
2. Dirty injectors.
3. Injection timing, or balancing between cylinders, out of adjustment.
4. Fuel limit control incorrectly set, ordinarily because it has been tampered with after it left the factory.
5. Overloading, ordinarily due to inexperienced operation.

The injection equipment of Diesel engines (pumps and injectors) should be inspected periodically. Several manufacturers recommend that their injection system be checked by means of specialized testing apparatus, easy to handle. Many fleet operators have a set-up to test the pumps and injection nozzles for proper balancing.

As our fuel and air mixture burns, releases its power, and becomes "exhaust gas" it is well to add a few words about the specifications of the fuel that make for efficient, powerful and smokeless operation. While a fuel heavier in gravity always contains more heat unit, hence more power, the fact should not be overlooked that the Diesel operator is primarily interested in usable power, and will frequently find it to his advantage to use a fuel slightly lighter in gravity because some of the other properties of this fuel make for more usable power per gallon. Of primary importance among these properties are: the ignition quality (cetane rating) and the volatility (distillation—end point). Other physical properties such as the "viscosity," to which exaggerated importance was given years ago, are of little consequence when kept between reasonable limits, as ascribed by the manufacturers of each type of engine.



ALBERT WIELICH

ALBERT Wielich of New York City, president of Lanova Corporation, died at the age of 63 on October 6 after a short illness. He was widely known in the Diesel Industry as one of the pioneers of high speed Diesels and of the Lanova Combustion System.

Mr. Wielich was born in Krefeld, Germany, went to Canada in 1906 and became an American citizen within a few years. He brought the first high speed Diesel to this country in 1924 and organized the Lanova Corporation in 1931. He is survived by a widow; two daughters, Miss Dorothy Wielich and Mrs. William Mertens, Jr.; also two brothers, Ludwig Wielich of Mountain Lakes, N. J., and Gotthard Wielich of Zurich, Switzerland.

Write for It!

HERMAN H. STICHT COMPANY, Inc., 27 Park Place, New York City, has just issued a new bulletin No. 715 describing the model DS chronometric Tachometer or Speed Indicator. This is a precision instrument for measuring of RPM and FPM, and a Tachometer of the chronometric type. The accuracy of the instrument is within ½ of 1% and its readability is exceptional. Catalog No. 2302 covers speeds between 0-2,000 RPM and readability per division is 1 RPM. Catalog No. 2301 suitable for all speeds from 0-20,000 RPM and one division represents 10 RPM.

Both ranges come in three different models with various accessories. Bulletin No. 715 shows complete pictures of each model and a full size reproduction of the dials on the Tachometer showing the exceptional readability. A copy of the bulletin will be furnished on request.

West Coast Diesel News

LAUNCHED at San Diego, California, by the San Diego Marine Construction Co., for the Star and Crescent Boat Co., the 65-ft., 500-passenger ferry *Juanita,* like the rest of this fleet, is powered with Cummins Diesels, twin 125 hp. marine engines with Twin Disc gears.

BRITISH Columbia boat builders continue installation of Diesels in new fishing vessels. Among the latest are two Washington 200 hp. engines in 78-ft. seiners being built by Pacific Shipyards, Ltd., Vancouver, and the Star Shipyard at New Westminister.

ENGINE modernizing service by Fairbanks-Morse Company is steadily gaining in popularity and one of their recent large jobs was that of the 108-ft. Van Camp Co.'s tuna clipper *Sacramento*. After fourteen years of service, her 400 hp. 14 x 17 in. Diesel, when modernized at one-third of original cost, showed a striking reduction in fuel cost, plus improved engine performance.

FAIRBANKS, Morse & Company, Los Angeles Branch, reports the sale of two of their Diesel generating sets to the Lynch Shipyard of San Diego, California. Engines are Model 35F, 2 cycle, 6 cyl., 240 hp. at 400 rpm.

THE Vancouver Tug Boat Co., Vancouver, B. C., has put in service their new tug *LaGarde;* 85 feet long, with 21½ ft. beam. She is powered with a 200 hp. Washington Diesel.

BRANCH Manager J. H. Czock, well known in Southern California as manager of the Terminal Island branch of the Atlas Imperial Diesel Engine Co., has been promoted to the main plant at Oakland, California.

AT the McKenzie Barge and Derrick Co.'s shipyard, Vancouver, B. C., a 78-ft. purse seiner is nearly completed for the Nootka Packing Company of Alaska. She will have as her main power a 200 hp. Atlas Imperial Diesel.

SIX Cummins 6-cylinder Diesels in Kenworth six-wheel tractors have been sold to Wells, Inc., for the 332-mile haul of magnesite between Gabbs and Las Vegas, Nevada. The engines are supercharged; load fifteen tons.

SOMETHING new in Diesel application is the installation in the Federal Reserve Bank of Los Angeles of a Caterpillar Diesel generator set—40 hp. at 1500 rpm. and G.E. 70 kw. self-regulating generator as standby power for control of bank time locks.

AN increasing number of Canadian fishing craft are being repowered with Diesels, and included in this fleet is the 40-ft. seiner of Ted Davidson, Sointula, B. C., with a new 68 hp. Buda-Lanova Diesel.

Korfund Equipment on U. S. Engineer Department Dredges

IT HAS been brought to our attention that the two G.M. 950 hp. main generating Diesels on each of the U. S. Engineer Department dredges, "Hains" and "Hoffman," are mounted on Korfund isolation equipment. We are glad to supplement the article on these ships, which appeared in DIESEL PROGRESS, with this information which came to us after the issue had gone to press.

Army-Navy Production Award To Ex-Cell-O

ON Friday, September 11, workers of Ex-Cell-O Corporation were awarded the Army-

Navy Production Award for ingenuity and initiative which has resulted in increased output of products for the Army and Navy. To minimize "down time" during the ceremony, all workers (approximately ten thousand in four plants) stayed at their machines while the ceremony, held in the main office, was broadcast to them over the company's P. A. System.

Phil Huber, President and General Manager of Ex-Cell-O Corporation, accepting the Army-Navy Production Award.

In presenting the Army-Navy "E" production award, Col. A. B. Quinton, Jr., Chief, Detroit Ordnance District said, "Back in years when we were doing planning work, before this war was thought of, Ex-Cell-O was on the job in developing machines and tools for the U. S. Ordnance, all of which have played a conspicuous part in the ability of this country to come along and produce in war . . . The operation of Ex-Cell-O Corporation is varied. You are making tools and parts for all branches of the service. Regardless of the type of work, its quality is of the best and your production is excellent. Your deliveries are either on schedule or ahead of schedule. The planning which the Ex-Cell-O Corporation has done in connection with this war production work is particularly praiseworthy . . . The ingenuity and initiative shown by the company and its employees have resulted in tremendously increased output, perhaps tripled what might have been expected under ordinary circumstances. The engineers of the Detroit Ordnance District have praised Ex-Cell-O for their inclination to solve their own problems. The training of employees in the Ex-Cell-O Corporation is another praiseworthy feature of your war production. You develop men here so that full advantage may be taken of their capabilities."

Ready-Power Company Expands

THE Ready-Power Company, Detroit, Michigan, manufacturers of Ready-Power units for the operation of electric industrial trucks, Diesel engine and gasoline driven generator plants, mobile power units, stand-by plants for emergency service and blackouts, has undergone a slow but steady growth since its founding in 1924. Its sales volume in 1941 was twice that of its best previous year. Due both to the increased wartime industrial activity and to the demands of our Armed Forces for Diesel engine driven generator plants, it became evident early in the year that greatly increased manufacturing facilities would be required.

Consequently, plans were made for the erection of a new plant and for a rearrangement of present facilities to accomplish this purpose. Original plans called for a single story brick, steel and concrete manufacturing building with an additional 11,000 sq. ft. of floor space to house the power plant division.

The temporary wooden buildings were quickly erected and were actually placed in service before priority details on the larger, permanent building, were completed. Due to a scarcity of steel, and the delay in securing priority as-

Critical materials are conserved in this new plant for Power Plant Division of The Ready-Power Company, Detroit, Michigan. Eight wooden unit buildings give required floor space, light, air, and break up fire hazards.

sistance for the erection of a large building, the Ready-Power Company found itself faced with the necessity of either making a complete new set of building plans, or erecting temporary wooden buildings as a substitute. Time being the vital factor in the program, the latter course was followed.

Detroit's building regulations do not permit the erection of a wooden structure of over 5000 sq. ft. of floor space. Fortunately, the proposed manufacturing operations could be divided up into seven separate and distinct classifications, each requiring about an equal amount of floor space. This made possible the erection of seven identical manufacturing buildings each housing respectively, the stores department, electrical assembly, power plant assembly, machine shop, carpenter shop, and blacksmith shop.

Two storage buildings and an office building complete this plant layout. Each manufacturing building and the office building is 60 ft. x 80 ft. long, and has its own hot air heating plant. To conserve heat and to keep temperature comfortable in the summer, the buildings are insulated with insulating board throughout.

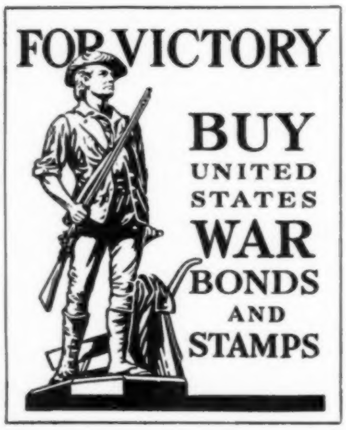
This new plant houses the power plant division of the Ready-Power Company only, and increases the floor space of this division six times. The industrial truck power unit division has taken over the plant formerly occupied by the power plant division. This has increased the floor space occupied by the industrial truck power division, by one-third. Most of the manufacturing operations, as well as the general offices of the Company, are maintained at the original plant, located on Grand River Avenue, Detroit.

As a result of these plant changes and additions, the Ready-Power Company's production for August, 1942, was increased by 150 per cent on industrial truck power units and by 400 per cent on Diesel and gasoline generator plants over their capacity at the beginning of the year.

Good News of Dave Craven

DAVE Craven, mentioned in the September issue of DIESEL PROGRESS as the first of the Cummins Engine Company personnel to volunteer his services to the Navy, is now Lieutenant Commander David S. Craven, U.S.N.R. He is Officer-in-charge of the Diesel Department of the U. S. Naval Supply Depot, Mechanicsburg. On leaving the Cummins organi-

zation, Lt. Commander Craven was assigned by the Bureau of Ships to set up the Diesel Department of the U. S. Naval Supply Depot.



Diesel Trucks Loaned To U. S. Engineer Corps For Instruction

THE Diesel trucks, owned by Caterpillar Tractor Co., recently departed from Peoria, Illinois, and from Caterpillar's San Leandro, California, plant to provide United States Engineer Corps second echelon instruction in 28 service camps throughout the country.

Formerly used as show trucks by Caterpillar in demonstrating functions of its products to the public, the trucks are now playing an important part in preparing service men for front line duties. An instructor and assistant, service department members, are in charge of each truck.

Second echelon instruction includes lectures and demonstrations on the construction and operation as well as the lubrication, maintenance, minor adjustments, and repairs of Caterpillar products. The trucks' cargoes include cutaways, animated wall charts, motion pictures, slide firms, and literature.

In general, this training parallels that given in the U. S. Army School set up at Caterpillar for the engineers. In this school third echelon instruction, which embraces more advanced maintenance and repair work, including dismantling and reassembly of equipment, is provided.

The itinerary of the Peoria truck includes Fort Knox, Kentucky; Greenville, South Carolina, McDill Field, Camp Blanding and Eglin Field in Florida; Savannah Air Base and Camp Gordon in Georgia; Fort Bragg in North Carolina; Richmond Air Base and Camp Pickett in Virginia; Georgetown, Delaware; Camp Edwards and Framingham, Massachusetts, and Camp Bradley in Connecticut. The truck is due to return November 20.

The San Leandro truck's schedule includes schools at Hammer Field and Camp Young in California; Camp Bowie in Texas; Camp Claiborne in Louisiana; Camp Shelby in Mississippi; Camp Crowder and Ft. Leonard Wood in Missouri; Camp Carson in Colorado; Ft. George Wright, Geiger Field and McChord Field in Washington. This truck is due back in San Leandro November 19.

Twelve Year Operating Record of Diesel Engines— Municipal Light & Power Plant, Ponca City, Oklahoma

PERIOD ENDING June 30	FUEL OIL GALLONS	FUEL OIL COST	LUB. OIL GALLONS	LUB. OIL COST	LABOR COST	MISC. & INCIDENTALS	MAINTENANCE COSTS ENGINE	MAINTENANCE COSTS AUXILIARY BLDG. ETC.	TOTAL OPERATING COSTS	GROSS K. W. HOURS GENERATED	TOTAL OPERATING COST/KW HR.	GROSS REVENUE, ELECTRIC ONLY
1929	774,692	$ 16,633.55	2,744	$ 2,690.65	$ 18,863.00		$ 3,873.55		$ 42,060.75	7,861,400	$.0054	$ 332,841.18
1930	818,331	14,545.75	3,305	2,283.70	19,101.75		2,671.00		38,602.20	8,431,000	.0045	328,139.83
1931	859,854	11,564.11	3,677	2,740.00	19,768.50		2,660.85		36,733.46	8,729,300	.0042	313,857.96
1932	850,763	8,454.60	4,234	2,287.41	18,662.50		1,621.90		31,026.41	8,766,800	.0035	289,371.68
1933	852,520	10,207.68	4,150	2,336.14	15,512.50		2,373.38		30,429.70	8,537,900	.0036	279,826.90
1934	899,922	13,231.79	4,504	2,391.37	17,060.00		3,580.18		36,263.34	9,161,800	.0039	291,185.74
1935	934,888	17,781.81	4,024	2,158.88	16,509.00		3,205.19		39,654.88	9,637,400	.0041	311,744.64
1936	1,003,436	18,173.59	4,017	2,002.90	15,934.00		3,849.04		39,959.53	10,115,500	.0039	326,797.35
1937	1,093,072	21,131.43	5,020	2,408.96	16,476.67		4,538.74		44,555.80	11,017,400	.0040	346,374.45
1938	1,059,771	23,662.32	5,349	2,169.19	18,930.00		3,961.79		48,723.30	11,247,585	.0043	363,853.42
1939	1,110,882	22,344.14	4,861	2,440.34	21,627.10		3,818.37		50,229.95	11,955,300	.0042	369,515.15
1940	1,140,065	24,983.16	5,834	2,448.10	21,125.51		3,379.72		51,936.49	12,224,000	.0042	392,721.51
TOTAL	11,398,196	202,713.93	51,719	28,357.64	219,570.53		39,533.71		490,175.81	117,685,385		3,946,229.75
AVERAGE 12 yrs.	949,850	16,892.83	4,310	2,363.14	18,297.54		3,294.48		40,847.98	9,807,115	.00417	328,852.48

HOURS OPERATED

YEAR 1/1 to 12/31	ENGINE #1 BHP 1250	ENGINE #2 BHP 1250	ENGINE #3 BHP 1250	ENGINE #4 BHP 1250	ENGINE #5 BHP 2250	ENGINE #6 BHP	TOTAL
1929	5,103	5,728	2,971	913.25			14,715
1930	5,332	6,155	2,606	1,473			15,566
1931	5,572	6,345	3,167	736			15,820
1932	5,261	5,614	2,444	1,938			15,257
1933	5,181	5,765	2,247	2,616			15,809
1934	3,600	4,683.5	5,104	3,416			16,803
1935	3,494	5,608	5,371	2,809			17,282
1936	5,083	6,042	4,568	2,937			18,630
1937	4,300	5,827	4,391	3,188	* (769)		18,475
1938	1,552	3,015	2,678	2,975	6,245		16,465
1939	3,095	3,716	1,532	2,606	6,014		16,963
1940	2,878	3,467	3,159	2,703	5,424		17,631
TOTAL	50,451	61,965.5	40,238	28,310.25	18,452		199,416
AVERAGE	4,204	5,164	3,353	2,359	5,894		16,618

FUEL OIL ANALYSIS

YEAR	1937		
Baume @ 60° F.	9.2		
Flash Point	255		
Fire Test	320		
Pour Test	-5		
Carbon Residue	9.75		
Sediment	0.4		
Water	0.0		
Sulphur	0.48		
Acidity	0.0		
Viscosity @ 70° F.	452		
Ash	0.01		
B.T.U. per Pound	18,047		

- FUEL OIL -
Cost per Gal., Averaged --- .01778
K.W.Hrs./Gal., Averaged --- 10.325
Cost/K.W.Hour, Averaged --- .0016

* Hours of Partial Year not Included in Average

- LUBRICATING OIL -
Cost/Gal., Averaged ---------- .5483
Rated HP Hrs./Gal., Averaged -- 517.7
K.W.Hrs./Gal., Averaged ----- 2277
Cost/K.W.Hour, Averaged ------- .00024

- MAINTENANCE -
Cost/Year, Averaged ----------- 3,294.48
Cost/Installed HP/Yr., Averaged - .583
Cost/K.W. Hour, Averaged ------- .00034

SIGNED Pat Schlesinger

TITLE Water and Light Superintendent

Army and Navy "E" to American Bearing Corporation

Rear Admiral William C. Watts addressing officials and dignitaries at American Bearing Corporation Army and Navy "E" ceremonies.

AMERICAN Bearing Corporation, a large supplier to the Diesel industry, has been recognized for its efficiency by the award of the coveted Army and Navy "E." At an impressive ceremony held in the company plant and attended by the employees in a group, the Navy was represented by Rear Admiral William C. Watts, U.S.N. (Retired), who presented the award and Commander G. H. Bowman, U.S.N. (Retired) who presented the employee's "E" pin. Musical selections were given by the Indianapolis Newsboys' Band under direction of J. B. Vandaworker. The address of welcome was delivered by Reginald H. Sullivan, Mayor of Indianapolis. In acknowledging the honor, Peter Lambertus, President, addressed his employees as follows: "To every man and woman in our plant, I express now my sincere thanks for their excellent work, which has won for us the right to fly the treasured Army and Navy "E" burgee. This award gives each of you the privilege of wearing the Army and Navy "E" button or pin. The emblem is not lightly bestowed. It goes only to those who are contributing in a substantial way to our common war effort. I hope you will wear it proudly as a symbol not only of your patriotism, but also as a reminder to everybody you meet that you are doing your full share to produce equipment

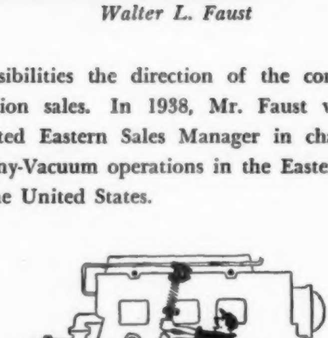
in which the fighting men of our Army and Navy can have full confidence. While they face the brunt of battle, we work—you and I—to the utmost of our strength, until ours is the victory."

Ceremonies were followed by an official dinner at the Columbia Club, Indianapolis.

Socony-Vacuum Oil Company Elects Walter L. Faust Vice President

MR. Walter L. Faust was recently elected a Vice President of the Socony-Vacuum Oil Company, Inc. Mr. Faust joined the Vacuum Oil Company in 1929 and became manager of the Marine Sales Department of the Vacuum Oil Company and later of the Socony-Vacuum Oil Company. In 1935, he added to his responsibilities the direction of the company's aviation sales. In 1938, Mr. Faust was appointed Eastern Sales Manager in charge of Socony-Vacuum operations in the Eastern part of the United States.

Walter L. Faust



Fairbanks-Morse Appoints Boston Branch Manager

DIESEL people in New England will soon be getting to meet and know John C. Elmburg, recently appointed manager of the Boston Branch of Fairbanks, Morse & Co.

The new manager has come on East from St. Paul where, as Diesel manager of the St. Paul Branch of Fairbanks, Morse & Co., he was

largely instrumental in the widespread growth of Diesel plants in the territory north of Chicago.

John C. Elmburg

The Coast as well as the interior of New England will get to know him, for he has also had a thoroughgoing experience with Marine Diesels, as he has applied his talents in that line from the Great Lakes to the Atlantic Ocean.

John Elmburg succeeds, as manager of the Boston Branch, R. H. Morse, Jr., who has become Assistant Sales Manager of Fairbanks, Morse & Company in its Administrative Offices at 600 South Michigan Ave., Chicago.

Enterprise Acquired by Transamerica

IT HAS BEEN REPORTED that Enterprise Engine & Foundry Company of San Francisco was recently acquired by Transamerica Corporation, also of San Francisco but that the company will continue to operate under its present management.

An Aid to Selection of Electric Motors

THE Allis-Chalmers Mfg. Company, Milwaukee, Wisconsin, has released a new motor bulletin, designed to give all the facts necessary for quickly choosing correct motors for wartime applications, thereby fully utilizing electric motor power and conserving vital war materials.

In the new book, Bulletin B6052-C, compact, simplified charts permit the reader to determine at a glance all electrical and mechanical characteristics of the motor types designed for the specific application in which he is interested. For each design and application relationship, rating, duty, torques, starting current, efficiency and slip are indicated—for squirrel-cage, wound rotor, direct current and synchronous motors.

In addition, construction features of various Allis-Chalmers Lo-Maintenance Motors are completely described and numerous typical applications are illustrated. The compact motor manual also includes handy speed-torque curves, as well as discussions of several engineering phases of motor application, such as the recommended use of higher speed motors

and adjustable speed. Dimension ratings and price lists are likewise included.

Copies of Bulletin B6052-C are now available on request.

Frank E. Blanchard

FRANK E. Blanchard, 54 years old, sales engineer in the engine department of Caterpillar Tractor Co., Peoria, Illinois, died suddenly at his Peoria home September 14.

The son of Edward S. and Myrtle A. Blanchard, he was born in Toledo, Ohio, September 19, 1887. He was married to Miss Laura F. Schroeder at Monroe, Michigan in 1909.

Mr. Blanchard was associated with the Milburn Wagon Co. from 1913 to 1920 and from 1920 to 1924 with the Buda Company of Harvey, Illinois. He was employed by the Climax Engineering Co. of Clinton, Iowa, from 1925 until he came to Peoria to join Caterpillar in 1935.

He was very active in promoting the use of multiple engined Diesel-Electric locomotives and was well known to operating and mechanical departments of many of the railroads all over the United States, as well as to general equipment men and engineers.

Surviving are his wife, his mother, a brother, Ned of Toledo, and a son, Sgt. Frank E. Blanchard, Jr., with the U. S. Air Forces in the Pacific.

New Bearing Lubrication Bulletin

"A GUIDE to Better Bearing Lubrication" distributed by SKF Industries, Inc., Philadelphia, manufacturers of ball and roller bearings, fills a vital need in all industries. Thirty-two pages are filled with designs, formulae, and graphs which explain the highly technical text. Subjects treated include the functions of lubrication, oil lubrication, recommended viscosities, oil supply systems, oil bath, circulating systems, spray or mist lubrication, wick feed, oil with compressed air, grease lubrication, how grease lubricates, ABEC grease standard, operating conditions, greasing intervals, grease supply systems, housing with grease fittings, housings without grease fittings, grease chamber lubrication, comparative advantages of oil and grease, high-temperature applications, minimum friction applications, protection against moisture, protection of idle machinery, cleaning. A free copy of this bulletin will be supplied upon request to SKF Industries, Inc., Front and Erie Sts., Philadelphia, Pa.

Army-Navy Flag for National Forge

THE recent presentation of the Army-Navy Flag to National Forge & Ordnance Company, Irvine, Warren County, Pa., marks the fourth award this company has received for excellence in production in less than a year.

National Forge was first honored for such meritorious effort by the Navy Ordnance "E" pennant on Nov. 22, 1941. This was followed by the All Navy "E" burgee on April 17. Then came the first White Star on May 23, signalizing the maintenance of award winning standards for the six months following the first "E."

Having already won the White Star, National Forge was privileged to add it to its Army-Navy Flag the day it was first unfurled at the plant. Thus, National Forge is one of the few companies to have a White Star on its Army-Navy Flag at the time of presentation.

New Centrifugal Pump Bulletin

A MOST compact compilation of facts on centrifugal pumps is offered in Bulletin B6059-H, recently released by the Allis-Chalmers Mfg. Company.

The variety of emergency wartime applications has been kept in mind in preparing the concise descriptions, charts and diagrams in the new book. Construction features, sizes and capacities are listed in a manner which simplifies the choice of proper pumping equipment for specific needs.

Included in the bulletin are pump types for every purpose—single and double suction, single and multi-stage, mixed and axial flow, combined Allis-Chalmers units and special pumps to solve special problems. Recommended ap-

plications for the one-package pump unit, the Allis-Chalmers Electrifugal, are also included.

Centrifugal pump users can now obtain copies of this new book by writing Allis-Chalmers, Milwaukee, Wisconsin.

Busch-Sulzer Adds Comptroller To Staff

VICTOR F. Melin, Jr., took over his duties September 1 as the first comptroller to be employed by the Busch-Sulzer plant at St. Louis. Melin came to Busch-Sulzer directly from Ellsworth City, Pa., where he had been works auditor of a large metal company. Prior to that he

Victor F. Melin, Jr.

was associated with Bendix Aviation Corporation's radio division in Baltimore, Md., and for nine years was cost auditor of the Kellog Switchboard and Supply Company.

Helpful New Booklet On Tractor Maintenance

"KEEP 'Em Working" is the title of a new book published by Caterpillar Tractor Co. of Peoria, Illinois, to aid owners of Caterpillar products in getting the most out of their machines.

Supplementing Operator's Instruction Books, "Keep 'Em Working" gives the reasons behind the maintenance and operation instructions, goes into greater detail on the care of certain critical parts and gives general information that is not conveniently available elsewhere.

Owners of Caterpillar equipment interested in receiving a free copy of this book should request Form No. 7609.

General Electric Issues New Motor Fitness Manual

MOTOR fitness requirements is the subject of a new 40-page illustrated bulletin (GED-1017) recently issued by General Electric Company.

Although primarily intended for plants converted to war production, the bulletin will prove valuable in all pants in which motors are widely used.

The bulletin discusses the following subjects in a highly comprehensive and informative manner: How to get the most service out of old and new motors, "switching" motors from one job to another, and equipping old machines with new motors.

Also, selection and application of motors, various types of motor enclosures, secondary ratings of standard integral-hp. motors, ways to determine WR squared, motor maintenance, full load currents of motors, selection of a-c control, and the use of the hook-on voltammeter. A

supplement explains how to save critical motor materials, including WPB recommendations, and information on the use of load-time-temperature charts.

The bulletin is arranged throughout for quick reference.

Colloidal Graphite Bulletin

A NEW 4-page informative bulletin, No. 421-P, on the use of "dag" colloidal graphite as a lubricant for running-in internal combustion engines, compressors, and other mechanical equipment, has just been published by the Acheson Colloids Corporation of Port Huron, Michigan. A free copy will be mailed on request.

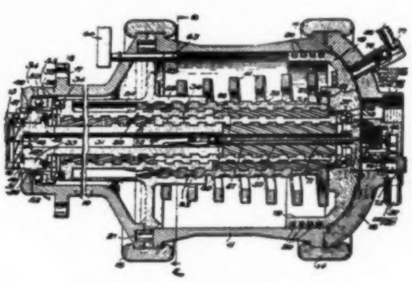
Five dollars buys the new edition of the Diesel Engine Catalog, Volume 7. See pages 66 and 67 for further details.

Latest Diesel Patents

A description of the outstanding patented inventions on Diesel and Diesel accessories as they are granted by the United States Patent Office. This information will be found a handy reference for inventors, engineers, designers and production men in establishing the dates of record, as well as describing the important Diesel inventions.

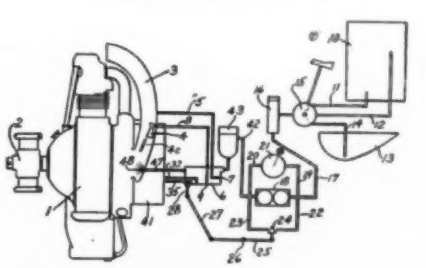
Inquiries and Patent Work Solicited
Conducted by C. CALVERT HINES*

2,283,185
DIESEL ENGINE STARTER
Roscoe Alexander Coffman, Pittsburgh, Pa.
Application July 15, 1935, Serial No. 31,519
20 Claims. (Cl. 121—37)



1. In an engine starter having a piston and a rotary crank shaft operated thereby, a clutch member associated with said crank shaft adapted to engage a member to be turned, and means acting on said clutch member and permitting the same to move into complete engagement with the member to be turned independently of the cranking or power rotative movement of the crank shaft and prior to the application of normal working power to said clutch member.

2,281,411
FUEL CONTROL APPARATUS FOR INTERNAL COMBUSTION ENGINES
John F. Campbell, Dayton, Ohio, assignor to George M. Holley and Earl Holley.
Application March 2, 1938, Serial No. 193,598
11 Claims. (Cl. 261—39)

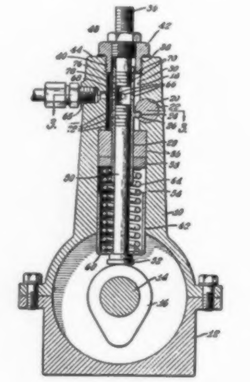


1. Fuel control means for an internal combustion engine comprising an air induction passage, means in said passage responsive to air flow therethrough to provide a differential fluid pressure proportional to air flow, a source of liquid fuel under pressure, and a conduit connecting the source with said induction passage, said fuel conduit including means responsive to fuel flow to provide a differential fluid pressure proportional to the rate of fuel air differential pressure, a second device subject flow, a device subject to and movable by the to and independently movable by the fuel dif-

* Patent Attorney, 811 E. Street, N.W., Washington, D. C.

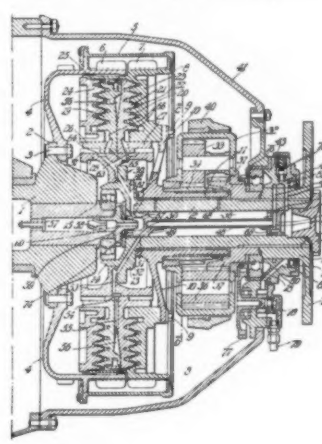
ferential pressure, a flow regulating valve controlling the effective capacity of the fuel conduit, a servomotor for operating said valve, means shiftable by the first device to positions determined by the measured rate of air flow, independently movable means shiftable by the second device to positions determined by the measured rate of fuel flow, and linkage means interconnecting the two last named means with the servomotor to move said valve to increase or decrease the capacity of said conduit depending upon whether the measured rate of fuel flow is respectively less or greater than that required to provide a predetermined variable fuel air ratio with the measured rate of air flow.

2,282,562
DIESEL ENGINE FUEL PUMP
Wheeler J. Cole, Ann Arbor, Mich.
Application November 7, 1939, Serial No. 303,337
7 Claims. (Cl. 103—41)



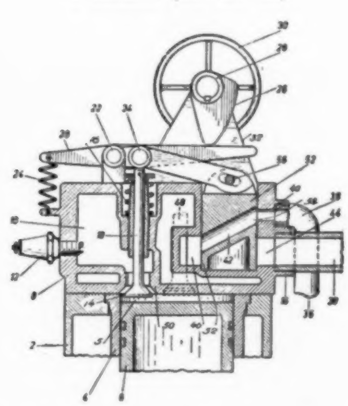
1. A fuel injection pump comprising a casing having a fuel chamber; a fixed plunger having a fuel outlet passage; a reciprocatory fuel injection plunger arranged coaxially with the fixed plunger; an adjustable fuel metering sleeve slidable axially on said first plunger and slidably receiving said reciprocatory plunger; a sealing means extending circumferentially about said sleeve and comprising a wall portion of said fuel chamber; said fixed and reciprocatory plungers being axially spaced and said sleeve having a port placing the interior of the sleeve between the fixed and reciprocatory plungers in communication with said chamber; said reciprocatory plunger closing said port upon a predetermined fuel injection stroke travel relatively to the sleeve to force fuel trapped in the sleeve through said fuel outlet passage; and means for shifting said sleeve relatively and axially of said fixed and reciprocatory plungers to vary the amount of fuel trapped in said sleeve.

2,289,991
TRANSMISSION GEAR FOR ENGINES
Edward Philip Paxman, Colchester, England.
Application December 6, 1939, Serial No. 307,889
In Great Britain December 9, 1938
6 Claims. (Cl 74—298)



1. An engine control mechanism having a driving shaft and a driven shaft having an inner end adjacent to and aligned with an end of said driving shaft, the mechanism comprising a torsionally flexible coupling straddling the adjacent ends of said shafts and having one element mounted on said driving shaft and a second element mounted on said driving shaft contiguous to the inner end thereof, a clutch device mounted concentrically within said flexible coupling and straddling the adjacent ends of said shafts and comprising driving clutch members fixed to the second coupling element and driven clutch members movably mounted upon and rotatable with said driven shaft, said driven shaft being driven through the clutch mechanism when running under full power transmission, and means mounted on said driven shaft contiguous to the point of mounting thereon of said second coupling element to transmit a reverse running drive from the second coupling element through at least one of said driving clutch members to the driven shaft.

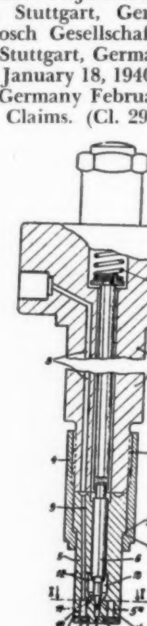
2,290,646
STARTING APPARATUS FOR DIESEL ENGINES
Willy Lehmann, Cottbus, Germany, assignor to "Famo" Fahzeug-und-Motorenwerke, G. m. b. H., Breslau, Germany, a corporation of Germany.
Application June 25, 1940, Serial No. 342,397
In Germany June 23, 1939
6 Claims. (Cl. 123—32)



5. In a Diesel type engine having an auxiliary ignition starting system, an intake valve for the main combustion chamber of said engine, a

passageway in the cylinder head of said engine extending from an air port to said valve, a cylinder intersecting said passageway adjacent said intake valve so as to leave a very short passage between said cylinder and said intake valve, an air-fuel port in said cylinder, and a piston valve having a bore therethrough movably mounted in said cylinder to open said passageway and close said air-fuel port in one position and to place said air-fuel port into communication with said short passage through said bore while closing said passageway to said air port when in another position whereby both air and air-fuel mixture have a common path through said cylinder head only through said short passage adjacent said intake valve.

2,286,658
COOLED INJECTION NOZZLE
Willy Voit, Stuttgart, Germany, assignor to Robert Bosch Gesellschaft mit beschrankter Haftung, Stuttgart, Germany.
Application January 18, 1940, Serial No. 314,517
In Germany February 2, 1939
5 Claims. (Cl. 299—107.1)

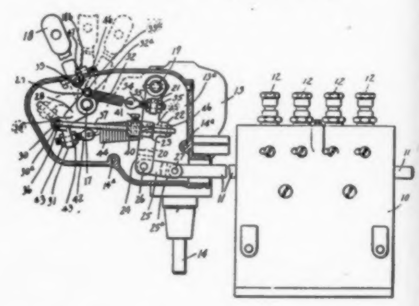


4. A fuel injection nozzle for internal combustion engines comprising, a nozzle holder provided with a fuel inlet channel and having a flat inner end, a nozzle body provided with a fuel channel and having a flat end adapted to contact in fluid-tight relation the flat end of said holder, with said fuel channels in register, means including a screw sleeve through which said nozzle body extends and which engages a shoulder intermediate the ends of said nozzle body to secure said nozzle body tightly on said holder with a free end of said body extending unobstructed for some distance from said sleeve, a nozzle needle in said body, said body being

formed to provide integral therewith an exit nozzle jet opening directly into the free end of said body and a seat for said needle, the face of the free end of said body being provided with an annular recess surrounding said seat and said jet and opening into said face, and a cover member tightly secured to the free end of said body and closing the open side of said recess to define a cooling chamber which communicates with said fuel channel and with said nozzle jet and valve seat by means of a bore and a control chamber provided in said nozzle body between said bore and said exit nozzle jet whereby fuel is delivered first to said cooling chamber and then to said nozzle jet, the outlet of said fuel channel and the inlet of said bore to said cooling chamber being separated by a bar portion provided across the annular recess in said nozzle body.

2,241,096
WIDE RANGE GOVERNOR FOR DIESEL ENGINES

Neel M. McCullough, Anderson, Ind., assignor to The Pierce Governor Company, Anderson, Ind., a corporation.
Application Dec. 24, 1937, Serial No. 181,680
17 Claims. (Cl. 264—3)



2. In a single governor structure for an engine, the combination of a lever, a single centrifugal device connected thereto for lever movement, a manually operable means for moving the lever, a pair of springs, and means operatively connecting said springs to the manually operable means and lever such that the lever is always spring constrained, said spring constraint being applied by each spring in succession and independently of the other spring time of application.

3. In a single governor structure for an engine, the combination of a single centrifugal device, arm means tiltable by the device, a fuel control means connected to the arm means remote from the tilting axis thereof, a main load spring connected to the arm means between the control means connection thereto and the tilting axis thereof, an auxiliary spring operatively connected at one end to the arm means between the tilting axis thereof and the load spring connection to the arm means, the opposite end of the auxiliary spring being relatively stationarily mounted, and lever means pivotally supported between the springs and including a manually movable end and an oppositely directed extension to which the other end of the load spring is connected.